DECEMBER 1954

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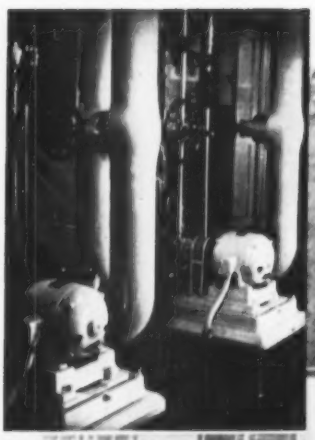
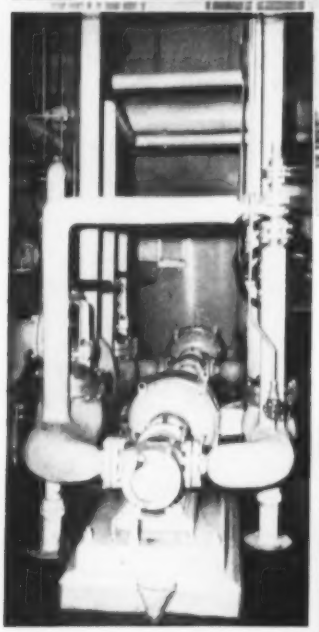
Circulation of this Issue 36,120

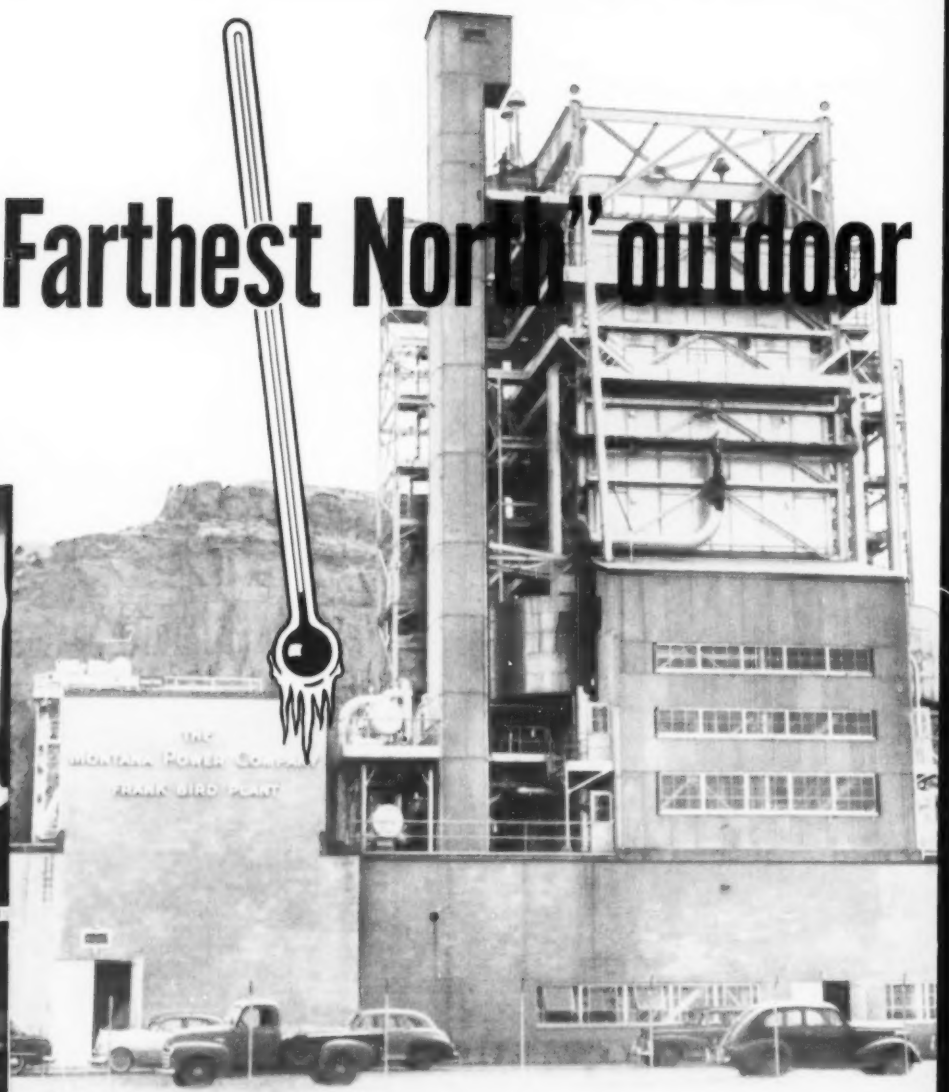
In this "Farthest North" outdoor





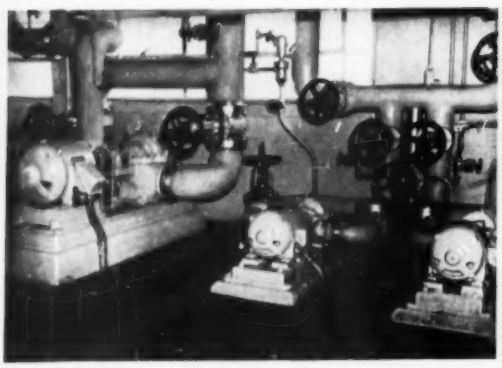
Some of the many Elliott C-W motors on pumps for oil burners, fuel oil transfer, condensate transfer, etc., as well as a number of other auxiliaries.

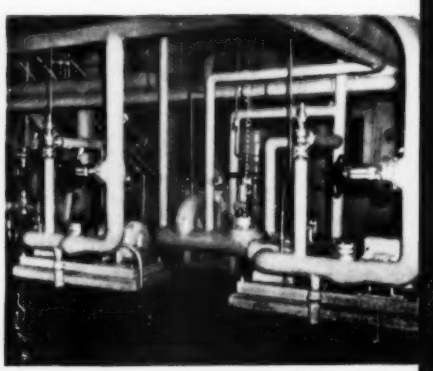
Q3-6



Winters can be severe on the rugged banks of the historic Yellowstone River, where the Frank W. Bird plant is located.

The station was designed and constructed by Ebasco Services, Incorporated.





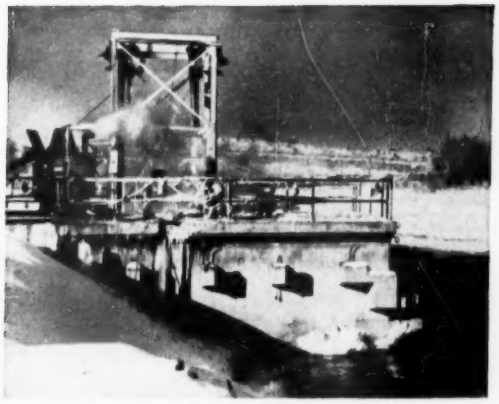
type station...

ELLIOTT MOTORS

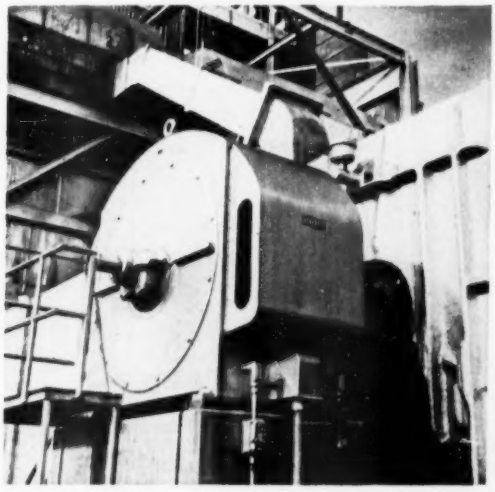
FORTY BELOW is not an uncommon winter temperature at the Frank W. Bird Steam-electric Station of the Montana Power Company, near Billings. Blizzard conditions too, naturally. Pretty tough sleddin' for exposed equipment, but not too tough for the Elliott 1000-hp motor driving the induced draft fan in the picture at the right. This is the increasingly popular outdoor splashproof (weather-protected) design that needs no ducts nor cored foundation. A similar motor of vertical type, 500-hp, drives a circulating water pump located on the exposed river bank. Other large Elliott motors serve the plant in less exposed locations, as well as a number of Elliott Crocker-Wheeler motors of open dripproof type on auxiliaries — quiet, capable performers, all doing their share in holding station costs down.

Your local Elliott representative or district office will give you complete data on the Elliott motors mentioned, or any other types you may need. Or write Elliott Company, Jeannette, Pa.

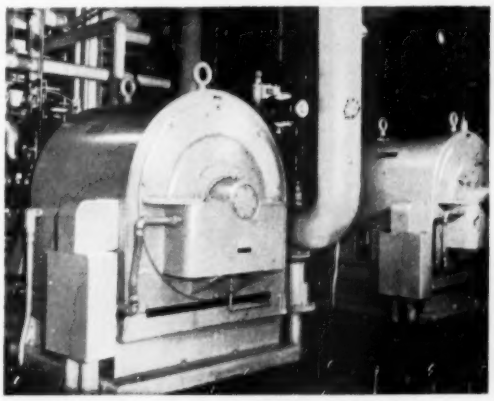
ELLIOTT Company



Out on the open river bank, buffeted by bitter winds, snow, sleet, etc., this Elliott 500-hp 12-pole vertical outdoor splashproof (weather-protected) motor drives a circulating water pump.



This Elliott 1000-hp outdoor splashproof (weather-protected) motor drives an induced-draft fan.



Two 1250-hp two-pole squirrel-cage induction motors on boiler-feed pump service.

TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS

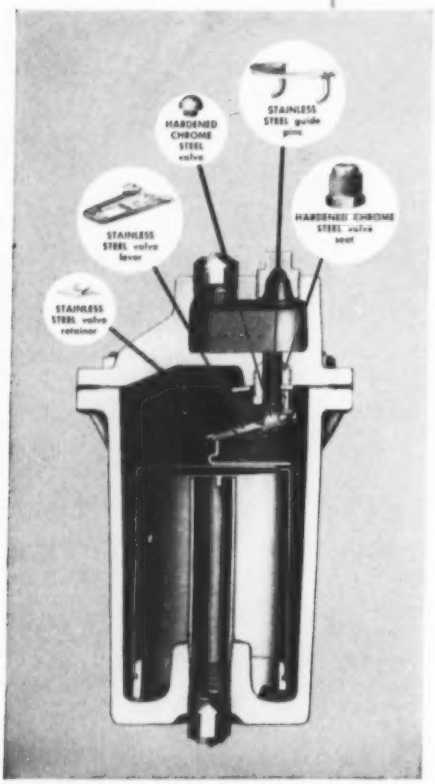
For more data circle 501 on Post Card

You will always get better results by putting a Steam Trap on each Steam Coil, Chest or Unit

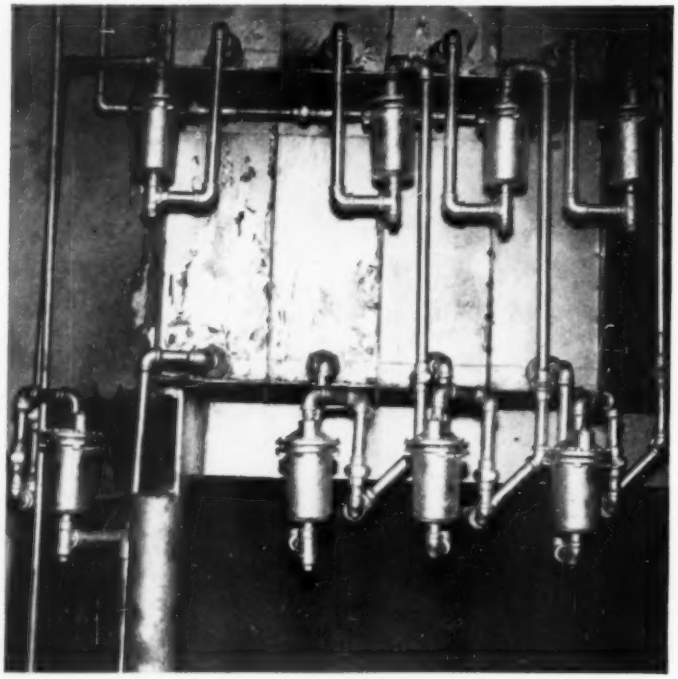
EXAMPLE

Dryer Temperatures at
Guelph Creamery, Guelph, Ontario.

WITH GROUP TRAPPING (5 steam traps for 10 coils)	**225°F**
WITH BLOW-THROUGH (no steam traps)	**250°F**
WITH ARMSTRONG UNIT TRAPPING (10 traps—one on each of 10 coils)	**309°F**


HARDENED CHROME STEEL valve
STAINLESS STEEL guide pins
STAINLESS STEEL valve lever
HARDENED CHROME STEEL valve seat
STAINLESS STEEL valve retainer

One of the big advantages of Armstrong traps is LOW MAINTENANCE. Mechanisms in low and medium pressure traps identical in design, workmanship and materials to those in 900°F, 900 psig traps.



The example at the upper left is simply one of thousands that bear out the benefits of "Armstrong *Unit* Trapping".

When you analyze it, the reason is quite obvious. No two steam coils, chests, chambers or machines will condense steam at exactly the same rate under operating conditions. There is a greater pressure drop in the units that condense the fastest. Steam will backflow through a common drain line from a higher pressure unit to a lower pressure unit. This blocks off flow of air and retards condensate flow from the lower pressure unit. On the other hand, if you separate each unit with its own trap, that can't happen.

You will *always* get higher temperatures and lower production costs with unit trapping. Ask your Armstrong Representative about it, or write:

ARMSTRONG MACHINE WORKS
810 Maple Street, Three Rivers, Michigan

FREE—STEAM TRAP BOOK

If you don't have a copy of the 44-page Armstrong Steam Trap Book, we'll be glad to send you one. No obligation.

ARMSTRONG STEAM TRAPS

For more data circle 502 on Post Card

ENGINEERS' PREVIEW

THE HEATING and ventilating industry will be host at Philadelphia to members of America's fastest growing profession, including 3,000 members of ASH&VE, when they gather for the 61st Annual Meeting, January 24–27, 1955.

The 12th International Heating, Ventilating and Air Conditioning Exposition, to be held in conjunction with the 61st Annual Meeting, will open at 2 P.M. on Monday, January 24 for a period of five days through Friday, January 28, at the Commercial Museum.

. . .

FURTHER ENCOURAGEMENT to American industry to take advantage of the products of government-sponsored technical research, is the publication of a volume listing 775 government-owned inventions in the field of instrumentation, with a brief description of each invention. Announcement of the publication was made by Dr. Archie M. Palmer, chairman of the Government Patents Board, Department of Commerce Building, Washington 25, D. C.

Dr. Palmer points out that these inventions are ordinarily available to the public on a royalty-free license basis. In addition to the brief description or abstract of the invention, each listing includes the patent number, the title of the invention, name of the inventor, and government agency administering the patent.

. . .

BITUMINOUS COAL Research, Inc., has appointed James R. Garvey to the position of assistant director of research, in charge of the Columbus branch office and laboratory. He will also serve as general manager of BCR Products, Inc. He succeeds Elmer R. Kaiser, who has accepted the position of director of research for the ASH&VE.

. . .

LIGHT-WEIGHT TITANIUM alloy considered suitable as a replacement for steel in military weapons has been developed for the Ordnance corps by Armour Research Foundation of Illinois Institute of Technology, during the course of a program being sponsored at the Foundation by the Watertown Arsenal laboratory, Watertown, Mass.

The titanium alloy is claimed to be 40 per cent lighter in weight than high-strength steel, highly corrosion-resistant, with properties which compare favorably with those of steel used in manufacturing weapons. The alloy shows tensile strengths up to 192,000 psi. This is approximately 42,000 psi stronger than any commercial alloy of titanium now being produced.

. . .

GOVERNMENT OF INDIA has purchased a 5-mile conveyor system to handle materials for the construction of the Bhakra Dam in the Himalaya foothills. It will be 680 ft high, the highest dam in the world except for the Hoover Dam on the Colorado River. The contract calls for a series of 46 conveyors to be linked together in a continuous line to carry sand and gravel over rugged terrain to a deep V-shaped gorge of the Sutlej River.

The dam will be constructed under the general supervision of an American engineer, W. H Slocum, who was project engineer for the Bull Shoals Dam in Arkansas. Some of the conveying equipment used in the construction of the Bull Shoals Dam will be used again on the Bhakra project. This equipment still retains about 90 per cent of its useful life, despite the fact it carried 4,000,000 tons of material at the Arkansas project.

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PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

POWER ENGINEERING

Reprints Available

WE HAVE on hand a small supply—50 to 100 copies—of each of the following articles published in POWER ENGINEERING in 1953:

How to File for Professional Engineer's License Examinations in State of New York
April 1953 issue

Artificial Respiration—New Improved Methods. July 1953 issue

Crane Accidents Can Be Prevented
October 1953 issue

If you want a free copy of each of these reprints, as long as our supply lasts, write the Editor, or note the title on one of the postage-free return postal cards elsewhere in this issue and mail it to us. One copy to a customer as long as they last.

● CHANGES in organization in the electric engineering department of Public Service Electric and Gas Co., of Newark, N. J., necessitated because of the recent death of Herman Weisberg, former mechanical engineer, are announced as follows: Robert A. Baker, from assistant to mechanical engineer, to power project engineer; Lee W. Lemon, from assistant to mechanical engineer, to mechanical engineer.

. . .

● THEODORE MAYNZ who retired as Steam-Electric Power Division Engineer of the American Viscose Corporation as of June 30, was retained on some special work until the end of September. Maynz had been with American Viscose almost 16 years in charge of electric and steam generation and distribution work. It is very likely that he will again enter consulting engineering practice exclusively in this field, as he did in Cleveland from 1924 to 1933.

. . .

● **BROOKHAVEN National Laboratory announced the selection of the Stone & Webster Engineering Corp. as architect-engineer of the building and supporting facilities for the 25,000,000,000-electron-volt proton synchrotron to be built at the Laboratory site in Upton, N. Y.**

The synchrotron will be housed in a doughnut-shaped tunnel approximately 20 ft in cross section. The hole in the middle will be over 800 ft across. The largest synchrotrons now in operation are the 3,000,000,000-v Brookhaven Cosmotron and the 6,000,000,000-v Bevatron at the University of California, which are, respectively, 75 and 100 ft in diameter. All three machines accelerate heavy particles (protons).

Although the machine itself will be designed and constructed by members of the Brookhaven Accelerator Development Department, Stone & Webster will design and supervise the construction of its housing and complementary equipment. This includes the doughnut-shaped tunnel, with foundations to support the 3000-ton magnet it will cover, heavy materials handling equipment, water cooling systems, and air temperature controls, as well as a large building to house the control room, laboratories, offices, electronics shops, and other services.

LETTERS TO THE EDITORS

Municipal Costs—Correction

I WISH TO THANK YOU for printing my letter, Municipal Power Costs, in the October issue of POWER ENGINEERING, page 5. In the second sentence of my letter, however, the word "not" was omitted in the publication. It should have read, "These costs are not given for the municipal power plant, City of Menasha Wisc." *Cornelius G. Weber, Milwaukee, Wisc.*

Editor's Note: We deeply regret this omission.

Two Reservoirs Supply Water for Dry Period

COMMENTS concerning the reference on page 3, Sept. '54 issue, about water conditions at the "TVA Kingston Tennessee Steam Plant," recalls a situation where another approach was used as follows:

The reference to the water conditions impels the writer to offer some details about the way the water problem was handled at a steel mill in India, where for a period of two to three months annually, the river, the principal source, was absolutely dry. Even during the rainy period following, usually June 15 to September 15, there were times when the sand carried by the flood, made pumping impossible.

The mill, largest unit mill in the British Empire 1935–1938, had an annual output exceeding 1,000,000 long tons, the product being most diversified including structural shapes, steel rails, steel plate, galvanized sheet and other products. To provide water for the "dry" period, two reservoirs had been constructed, an upper and a lower one with a 15-foot difference in elevation with both full.

Every possible effort was made to reclaim the water used by four blast furnaces, condensing water for a 50 MW plus electrical load, and water for domestic purposes. With air temperatures well up toward 120 F, injection water to the condensers even with a spray cooling system exceeded 100 F.

Under normal conditions, the water was pumped from the river to the upper reservoir, which had a fixed maximum water elevation and any excess was passed over a spillway to the lower reservoir, which had a fluctuating water elevation depending upon the river conditions for the season period.

The water from the lower reservoir was pumped to the upper one through a spray cooling system and taken from there to the point of use. The water returned from the works was discharged over a concrete inclined spillway into the lower reservoir. The spillway was sufficiently roughened to agitate the water and the aeration resulted in some cooling before reaching the lower reservoir from which, as described, it was pumped through a spray cooling system for further use. The lower reservoir had three to four times the area of the upper one.

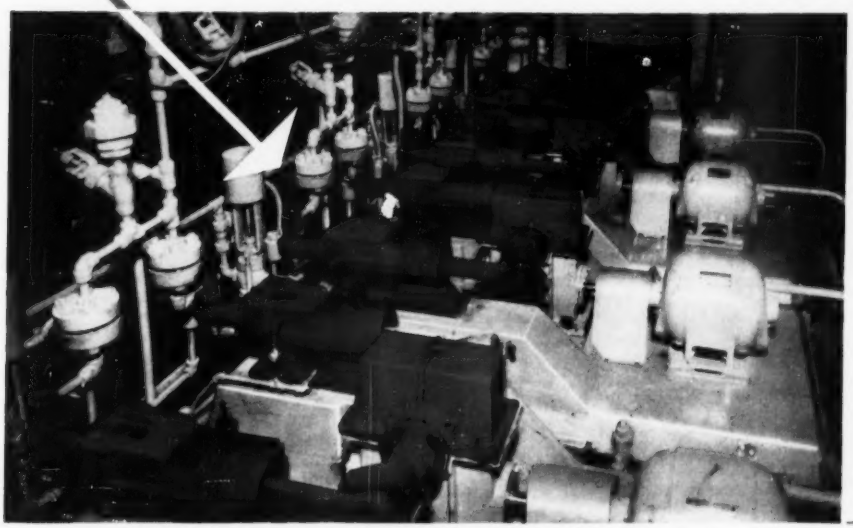
As the writer now recalls, one dry season there was no pumping from the river for nearly 90 days and it is of interest to learn whether a steel-making establishment of comparable output has operated for such a lengthy period as a self-contained unit with stored water alone. — *C. O. von Dannenberg, Brooklyn, N. Y.*

CHEMICAL PUMPS for *Boiler Water Treatment*

. . . for the SMALLEST industrial installation

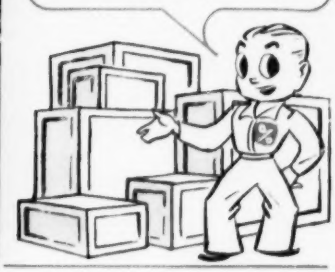
to the LARGEST central station

Simplex Model 1105-S Adjust-O-Feeder for feeds up to 20 GPH and into pressures up to 650 psi.



Battery of 2X Series — High Pressure Adjust-O-Feeders for phosphate treatment

We NOW stock STANDARD PROPORTIONING PUMPS suitable for most boiler water treatment needs—and can give immediate delivery.



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Other accessories pertinent to boiler water treatment are also supplied, including special dissolving and storage tanks, alarm systems, relief valves, automatic feeding and flushing systems, control panels, and control systems for flow-responsive actuation from new or existing flow meters.

Thousands of Proportioneers metering pumps are daily feeding chemicals to correct boiler water conditions — reducing boiler maintenance, minimizing operator responsibility, and providing positive control of chemical application. Write today for Brochure SM-9020. Proportioneers, Inc., 385 Harris Ave., Providence 1, R. I.

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For more data circle 503 on Post Card

HERE'S WHAT THEY TELL US

IF OUR PRACTICAL-MINDED readers ever want to know about the different power cycles, **Editor Andrew Kramer** tells us we could do no better than refer them to Croft's book. He says that Croft knew and understood his audience and was a very skilled writer with deep understanding of basic phenomenon.

Our editor believes nobody ever covered the subject of Entropy better or more simply than Terrell Croft did in his book, Practical Heat, first published in 1923.

• • •

JERRY QUINN, Allis-Chalmers Mfg. Company, Milwaukee, during a visit in our office, told us about the new atomic power plant to be built for Argonne National Laboratory. Allis-Chalmers will build the 5000-kw power equipment for the boiling water reactor.

In a letter to Mr. Quinn, Editor Kramer later made reference to Power Reactors, a paper on this steaming type of reactor and the sodium-cooled heterogeneous reactors written by Dr. Zinn. The paper was delivered by the author last September before the International Congress of Industrial Chemistry at Brussels. Editor Kramer considers it an unusually clear and down-to-earth discussion of reactor design. He told Mr. Quinn:

> I have been very much interested in this development ever since I first heard about it when I was in Idaho a year and a half ago. At that time, Dr. Zinn was just beginning his experiment and I have followed it ever since. It represents, to my mind, one of the two avenues of approach to an economic atomic power plant which will ultimately lead to success.

• • •

SOME TIME AGO, while Editor Kramer was visiting the new addition to Kearny (N. J.) Station, he was shown the high-pressure steam line, and was told that the 80-ft line between the superheater outlet and the turbine throttle cost $800 a foot. He said from this it was quite obvious why power plant designers try every way to reduce the distance between the boiler outlet and the turbine throttle.

• • •

TEDDY GILMER, Georgia Institute of Technology, recently told us in a letter:

> I am planning to write an article for the Georgia Tech *Engineer* based on an article in POWER ENGINEERING, June 1954, entitled Natural Gas To Be Liquefied and Transported by River Barge. I should like to use the illustrations you have used on pages 92 and 93.

Associate Editor Robert Mitchell, who had the photographs forwarded immediately to Mr. Gilmer, also included the following notes:

> It is no longer any secret that the Chicago industrial firm to make first use of the liquefied natural gas is the huge Union Stockyards, whose refrigeration requirements are as extensive as their heating and power generating requirements.
>
> You might be interested also in the fact that the British Ministry of Fuel is at present investigating the possibility of transporting liquefied natural gas from the Middle East to England via insulated tankers.

• • •

THE NEW HANDBOOK Section in POWER ENGINEERING brought a pleased response from many of our readers.

A. M. Griffith, The Cincinnati Masonic Temple Co., said:

> Your new idea of the POWER ENGINEERING Handbook Sheets is certainly a welcome addition to the magazine.

B. G. Davenport, Jr., Excelsior Mills Union, South Carolina, wrote:

> I believe that you have a very good idea in the new POWER ENGINEERING Handbook. If you decide to have the binders made up, sign me up, I'll take one.

A representative of Jones & Brakeley, Inc., reported:

> We just received the October issue which includes the beginning of POWER ENGINEERING'S Handbook. Wonderful idea! Seems like every time you get a copy of POWER ENGINEERING it is more useful than the preceding one.

The Handbook Section, which now appears as a regular feature of POWER ENGINEERING, made its debut in the October issue, pages 116, 118, 120. The Section occupied four pages in the November issue.

ONE OF OUR inter-office memos, written by **Executive Editor Chester Earle** to **Editorial Director Richard Morris,** contained a noteworthy paragraph which read:

> **Norman Jones, Associate Editor,** did a fine job in first following up the scattered comments on drilling of concrete and other masonry in power plant work a long time ago, and finally, digging out the very fine practical information prepared by **Bernard L. Chapin** and **Ralph H. Alper,** from New England Carbide Tool Company, the like of which you will not see anywhere else in the technical literature. The reprint is now ready.

The articles which comprise the Masonry Drilling reprint were published in June, July, August and September of this year. Write us if you want a copy.

• • •

IN THE CONTROVERSIAL area of the Oppenheimer case, our readers have expressed many yeas and nays. One of our friends felt so strongly about the subject that he told us flatly:

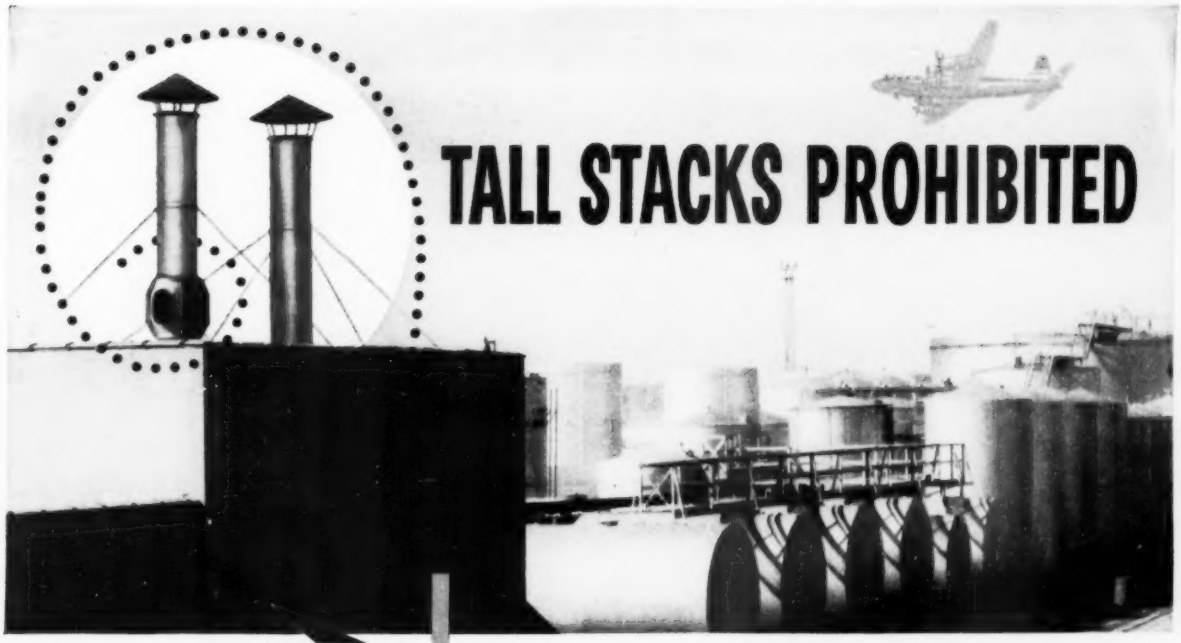
> It is my opinion that a technical paper should not be a "sounding board" for political propaganda — the September 14th release of your paper *Atomics* most certainly was.

Naturally, we believe that we have both a right and a responsibility as representatives of the technical press to give our opinions on any subject pertinent to our field. With so much atomic planning geared directly or indirectly to political strategy, the opinions of every scientist and engineer are sorely needed!

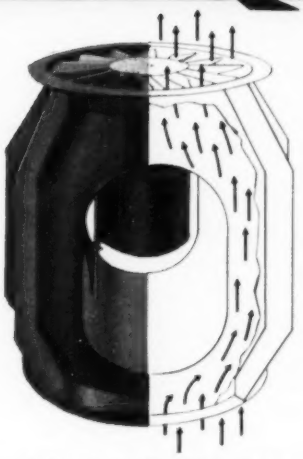
Offering favorable comment regarding Editor Kramer's stand in the case, **J. Howard Bowman,** Clarage Fan Company, Kalamazoo, wrote:

> Thank you for the September 14th *Atomics*. I most certainly agree with you in your comments about the treatment of Dr. Oppenheimer. That such things can happen to a person in this country is as much to be feared as a trigger-happy use of atomic bombs.
>
> We need more Smyths and Kramers.

Editor Kramer, who is a member of the Atomic Energy Commission, has been reading the original transcript of the hearings and knows that what he said about the transcript was perfectly true. Outside of reading the transcript itself, he highly recommends The Oppenheimer Case, October issue, *Atlantic Monthly*. It is an excellent source for learning what the hearings were about. Even more informative is the 18-page article on the Oppenheimer case by the Alsop brothers in the October issue of *Harpers Magazine*. Read it!



TALL STACKS PROHIBITED



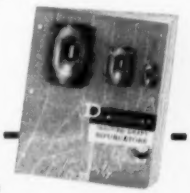
The Induced Draft Bifurcator is a motor-driven axial-flow fan in a divided housing. Motor is in an isolated chamber around which flue gases are by-passed so that motor always remains clean, accessible and at safe temperature. Induced Draft Bifurcators are built in 24 sizes, for high-pressure boilers delivering up to 60,000 pounds of steam per hour and for low-pressure boilers rated up to 190,000 EDR.

So Socony-Vacuum Lubricating Oil Plant insures boiler draft with Induced Draft Bifurcator Fans

This Socony-Vacuum oil blending and packaging plant is located near the Kansas City Airport, so they couldn't erect a tall stack for boiler draft. This restriction posed a problem because the plant requires two 150 HP boilers to provide steam for plant processes, tank car cleaning and barrel cleaning.

Socony-Vacuum engineers solved the problem by installing two Induced Draft Bifurcator Fans. One Induced Draft Bifurcator Fan is mounted in the breeching immediately above the boiler. The other Bifurcator is mounted on the roof because of limited space above boiler smoke outlet. These units provide adequate draft for the two 150 HP boilers — and they require only 12-foot steel stub stacks.

For full information on Induced Draft Bifurcators, simply **MAIL COUPON TODAY.**



DeBothezat Fans

Division of

American Machine and Metals, Inc.

EAST MOLINE, ILLINOIS

DeBOTHEZAT FANS DIVISION
American Machine and Metals, Inc.
Dept. PO- 1254, East Moline, Illinois

Please send free Bulletin DB-32-52 with full technical data on Induced Draft Bifurcators.

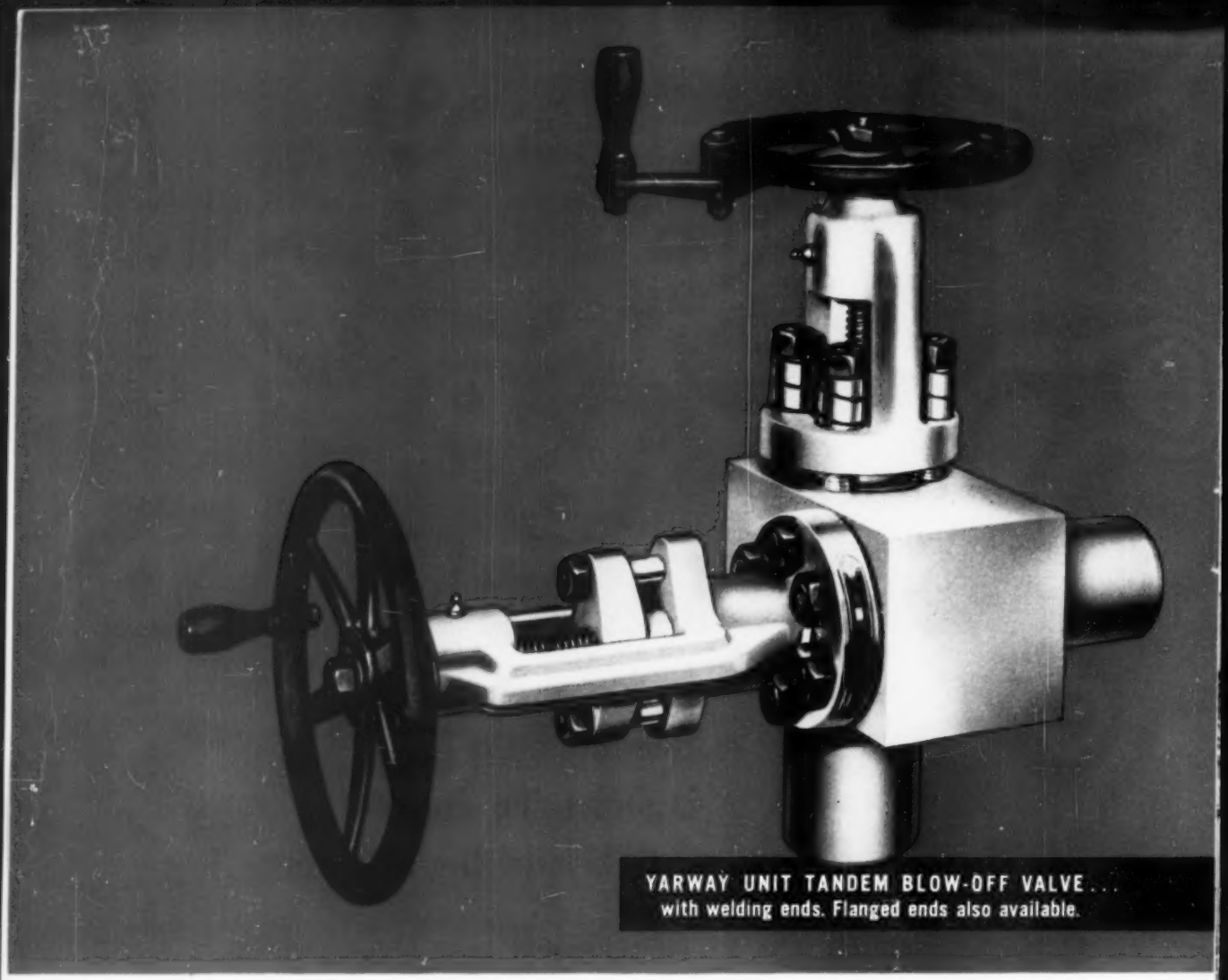
FIRM NAME

ADDRESS

CITY ZONE STATE

NAME AND TITLE

For more data circle 504 on Post Card



YARWAY UNIT TANDEM BLOW-OFF VALVE . . .
with welding ends. Flanged ends also available.

BUILT TO "TAKE IT" AT

HIGH PRESSURES

● As boiler pressures go up . . . so does the demand for Yarway Unit Tandem Blow-Off Valves. *Why do more than 4 out of 5 high-pressure boiler plants now use Yarway Blow-Off Valves?*

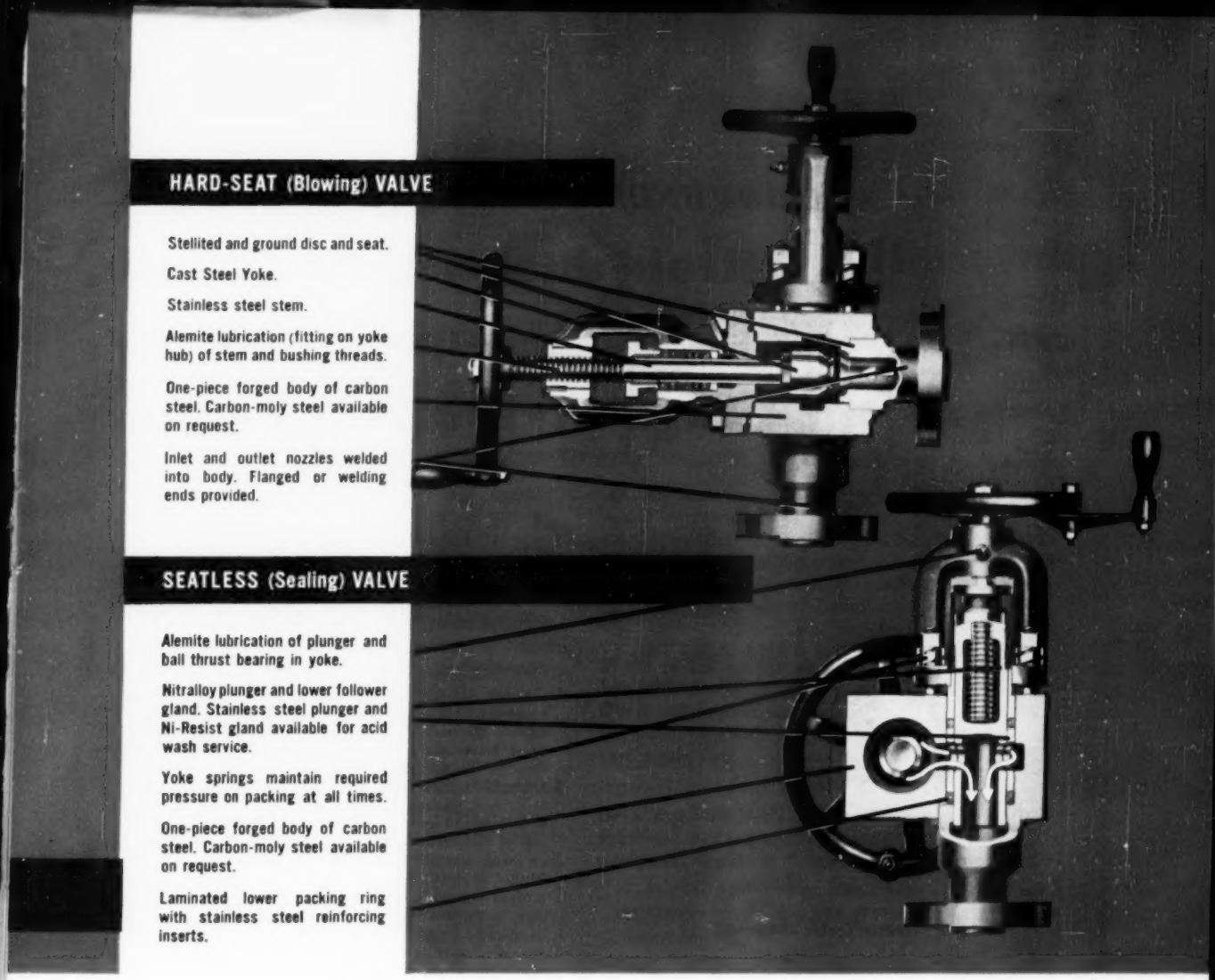
Yarway Unit Tandems are designed for strength, built to safeguard lives and investments, and to withstand severest acid-wash service.

A rugged, compact one-piece forged steel block serves as the space-saving common body for both valves, eliminating intermediate connections. Stelliting on seats and discs in the hard-seat valves provides longer life and better service. Balanced sliding plungers do the same on the seatless-type valves. Other design and metallurgy features add a high safety factor.

A FEW TYPICAL USERS

UTILITIES

Philadelphia Electric Company
Pacific Gas and Electric Company
Dallas Power and Light Company
Boston Edison Company
Cleveland Electric Illum. Co.



HARD-SEAT (Blowing) VALVE

Stellited and ground disc and seat.

Cast Steel Yoke.

Stainless steel stem.

Alemite lubrication (fitting on yoke hub) of stem and bushing threads.

One-piece forged body of carbon steel. Carbon-moly steel available on request.

Inlet and outlet nozzles welded into body. Flanged or welding ends provided.

SEATLESS (Sealing) VALVE

Alemite lubrication of plunger and ball thrust bearing in yoke.

Nitralloy plunger and lower follower gland. Stainless steel plunger and Ni-Resist gland available for acid wash service.

Yoke springs maintain required pressure on packing at all times.

One-piece forged body of carbon steel. Carbon-moly steel available on request.

Laminated lower packing ring with stainless steel reinforcing inserts.

Unit Tandems are available in the hard seat—seatless valve combination for pressures to 1500 psi, or in the hard seat—hard seat combination for pressures to 2500 psi. Both provide positive opening and closing with drop-tight shut-off.

Write for Yarway Bulletin B-434.

YARNALL-WARING COMPANY

100 Mermaid Avenue, Philadelphia 18, Penna.

BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY® blow-off valves

Toledo Edison Company
Georgia Power Company
Union Electric Co. of Missouri
Rochester Gas and Electric Co.
Indianapolis Power and Light Co.

INDUSTRIAL PLANTS

Bethlehem Steel Company
Ford Motor Company
Weyerhaeuser Timber Co.
Anheuser Busch Company
Procter & Gamble Company

Southern Kraft Corporation
Chrysler Corporation
Container Corp. of America
Eastman Kodak Company
American Viscose Company

Proven On loads *UNDER* 600 Amps....

Fusetron dual-element Fuses Have an Interrupting Rating in Excess of 100,000 Amps.

An interrupting rating in excess of 100,000 amperes for FUSETRON dual-element fuses . . . this was shown by tests that were conducted under conditions that simulated the most severe field conditions. These tests were witnessed and verified by the Electrical Testing Laboratories of New York.

The test circuits were set to deliver far in excess of 100,000 amperes — yet the 250 and 600 volt FUSETRON fuses cleared the shorts without igniting readily flamable material placed around the fuses . . . and there was comparatively little noise.

These tests show that Fusetron fuses, even in the small 30 ampere range, can interrupt safely the most severe available short circuit current.

No interference with time-lag

Time-lag is of utmost importance to give proper motor and electrical protection and to eliminate needless blowing of fuses. Even though the interrupting capacity has been greatly increased, the time-current characteristic of Fusetron fuses has in no way been disturbed.

ALL THIS ADDED SAFETY

without changing a panelboard or switch . . . plus 10 point Protection of FUSETRON dual-element FUSES!

1. Protect against short-circuits. **2.** Protect against needless blows caused by harmless overloads. **3.** Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation. **4.** Provide thermal protection — for panels and switches against damage from heating due to poor contact. **5.** Protect motors against burnout from overloading. **6.** Protect motors against burnout due to single phasing. **7.** Give double burnout protection to large motors — without extra cost. **8.** Make protection of small motors simple and inexpensive. **9.** Protect against waste of space and money — permit use of proper size switches and panels. **10.** Protect coils, transformers and solenoids against burnout.

Fusetron Fuses Help eliminate needless Shutdowns for Production Engineers.

Work stoppages caused by needless blows are prevented. Even if all the motors on a circuit start at one time or other harmless overloads occur, the fuse link holds to prevent a shutdown.

Likewise, Fusetron fuses guard against needless blows caused by excessive-heating in panelboards and switches—lesser resistance results in cooler operation.

Fusetron Fuses Offer Maximum Safety for Electrical and Safety Engineers.

With an interrupting rating of 100,000 amperes, Fusetron fuses give the greatest possible protection against damage due to short-circuits. And just as important, they reduce the hazard of motor burnouts due to single phasing and overloading.

Fusetron Fuses Save Time and Work for Maintenance Engineers.

Once properly installed, Fusetron fuses require no costly inspection time or down-time for calibration and other maintenance necessary on mechanically operated devices.

Unnecessary repair work on motors is avoided because Fusetron fuses reduce to a minimum the danger of damage due to electrical faults. If trouble occurs, instead of rewinding or replacing burned out motors, simply replace Fusetron fuses.

Switches and panelboards are protected against damage from poor contact heating.

Fusetron fuses also protect against needless blows that cause irritating interruptions of regular maintenance.

Proven On loads *ABOVE* 600 and up to 5,000 Amps.

BUSS Hi-Cap Fuses Have an Interrupting Rating In Excess of 100,000 Amps. . . *and their blowing time can be coordinated with that of Fusetron fuses.*

An unlimited interrupting rating for BUSS Hi-Cap fuses on any voltage up to 600 . . . this was confirmed by tests reported by the Electrical Testing Laboratories of New York.

BUSS Hi-Cap fuses are designed to give protection against dangerous overloads as well as high fault currents — yet retain the speed of operation necessary to limit heavy short currents to safe values.

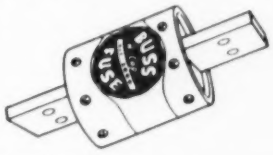
When coordinated properly with Fusetron dual-element fuses they will not open ahead of the fuse nearest to the fault — thus the trouble is isolated to the part of the circuit in which the fault occurs.

Added SAFETY on Old Installations

On installations where the increase in the capacity of the circuit has outgrown the interrupting rating of the circuit breakers, BUSS Hi-Cap fuses offer a safe and relatively inexpensive way to protect inadequate breakers against rupture in event of bad fault.

ACTION THAT SAVES YOU MONEY

Don't risk losses. Delay may cost you far more than replacing every fuse with a FUSETRON fuse. By passing the word along that all purchase and stock records should call for FUSETRON dual-element fuses on loads up to 600 amperes — and BUSS Hi-Cap fuses on loads above that, you get action that begets money saving.



On New Construction tell your architect to specify this Safer, Better Protection.

Fusetron Fuses Cuts Cost for Top Management.

Cuts maintenance cost — Fusetron fuses are maintenance free.

Cuts motor repair cost — Fusetron fuses guard the motor, against damage due to overloading, single phasing, short circuits and other electrical faults.

Cuts production costs — Shutdowns due to needless blows are eliminated.

Cuts new installation costs — Smaller sizes can be used, therefore big savings can be made on switches and panelboards.

Cuts present installation costs — Fusetron fuses hold and won't open on starting currents so the need for larger panelboards and switches is often eliminated — and in many cases new motors can be added to the circuit without installing larger panelboards or switches.

Play Safe—Install Fusetron Fuses and BUSS Hi-Cap Fuses now!

For blowing time charts or more information on FUSETRON fuses and BUSS Hi-Cap fuses use coupon or write for bulletin FIS and HCS.

FUSETRON

TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION

BUSS

BUSSMANN Mfg. Co.
(Division of McGraw Electric Co.)
University at Jefferson, St. Louis 7, Mo.
Please send me complete facts about FUSETRON dual-element Fuses and BUSS Hi-Cap Fuses.

Name _____

Title _____

Company _____

Address _____

City & Zone _____ *State* _____ 954

For more data circle 509 on Post Card

WATSON-STILLMAN

FORGED STEEL UNIONS

Designed and Manufactured to:

- **AAR SPECIFICATIONS**
- **ASTM A-105 GRADE 2**

We're happy to announce the arrival of these fine additions to our Forged Steel Fittings Family. Designed by Watson-Stillman engineers and manufactured on our new high precision machinery, these unions give you the utmost in serviceability in high pressure piping systems.

These outstanding features are just what you've been looking for:

1. All parts are drop-forged of high quality steel for maximum strength and toughness to resist shock and vibration.
2. Heavy, octagonal-shaped walls give you added protection at high pressures.
3. Steel-to-steel seat with ball-to-angle mating surfaces insures a tight, leakproof seal.
4. Nuts are plated with a heavy coat of cadmium to resist galling and seizing.

Watson-Stillman Unions are available in both Screw-End and Socket-Welding Types in sizes ⅛" to 2". For complete technical information write today for our new Union Bulletin.

Sold Through Leading Distributors

Send today for Bulletin U-1

WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.
Roselle, New Jersey

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HALL INDUSTRIAL WATER REPORT

Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.

Volume 2 | DECEMBER 1954 | Number 6

Close Control Pays Off in Clean Boilers

When Hall Service was started at an East Coast plant, R. A. Beardsley, service engineer, undertook to educate and interest all of the operating personnel in their water conditioning program, so that follow-through on his recommendations for better operation would not be left to "George." In this plant no actual failures had occurred, and because chemical treatment had been used, the personnel was convinced that such troubles as plugging of feed lines, poor distribution of chemicals, and the time and labor consuming cleaning job were necessary evils. The plant men were astonished when minor modifications in pre-boiler control and treatment practices, faithfully carried out, resulted in major improvements in the internal condition of four waste heat boilers.

Tight control now polices chemical treatment and adjustment of the phosphate-silica ratio in the boiler water has eliminated the adherent magnesium phosphate scale that was responsible for the massing of deposits.

Since the plant men had formerly taken it for granted that crowbars, chisels and hard labor were needed to get rid of heavy scale accumulations, washing out the greatly reduced amount of deposit right down to clean metal now seems like child's play.

Foreign Relations

One Hall staff engineer had to travel 8000 miles to go to work recently when a request for consultation came from the Arabian American Oil Company in Saudi Arabia. But setting up water treatment for boiler operation, for the protection of condensate lines and for air conditioning equipment at three plants made A. M. Henricks feel that he had never left home during the five weeks he spent in Arabia. Mr. Henricks' long-distance service job was one of several such trips he has made in the last few years.

Another phase of Hall Laboratories' foreign service is a training course which has been given to engineers and technicians from all parts of the world. Although this training is made available to Hall Laboratories' domestic clients, it is especially valuable to personnel from foreign plants in familiarizing them with the latest in water treatment.

Engineering and Industrial Wastes

In a Panel Discussion on Stream Pollution presented at the Fifteenth Annual Water Conference, H. A. Reda of Hall Laboratories defined "An Engineering Approach to Industrial Waste Problems." Viewing plant process and waste water problems as a part of an integrated program of water use leads to the systematic analysis that constitutes the engineering approach. Mr. Reda pointed out that "bonus" benefits frequently result when the investigator studies the entire water system in a plant in order to set up the most effective and economical treatment of industrial wastes. Recovery of costly process materials, reduction of water consumption, and re-use can help to offset the cost of treatment. In one plant, study of over-all water practices enabled Mr. Reda to reduce the preliminary $250,000 estimate by almost one half.

Mr. Reda's discussion brought out the value of the engineering approach in unraveling the complex waste disposal problems in plants built long before the pollution of streams was a consideration in industrial operations. In many of these older plants, no one actually knows how the piping is laid out. In some, where the water source is located on plant property, no measurement of flow rates has ever been made; probably such a plant would not even have a flow meter. In these plants, only an engineering approach can solve the problems effectively.

Hall Engineer Boosts Employee Morale

The several hundred employees of a glass manufacturing plant complained that hot water in the bath house was extremely hard and much too scarce. The shortage was due to a hard calcium carbonate scale which reduced shell-tube heater efficiency in a matter of days after each cleaning, and defied complete removal by either chemical or mechanical means.

When this unhappy situation was mentioned to Hall engineer W. J. Reese, he thought of the softened, Threshold-treated water used for make-up in the production cooling system in the plant. He pointed out that the blowdown from this cooling system, which had formerly run to waste, could be fed to the bath house heaters, thus eliminating the scale problem. Now everyone is happy . . . employees because they are getting adequate supplies of softened hot water, and management because a troublesome problem was licked without the purchase of costly water softening equipment.

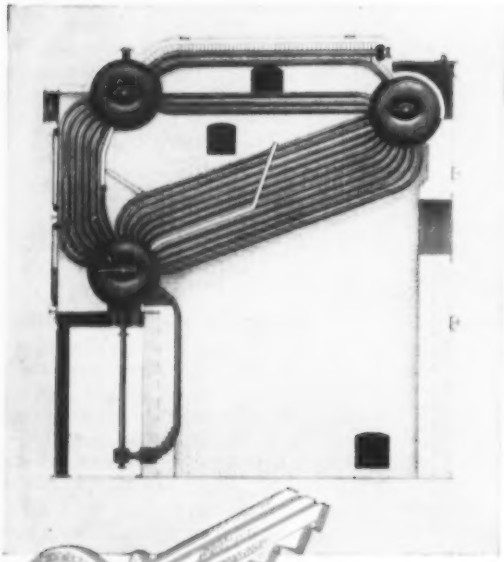
Close Contact Maintained by Hall Executives

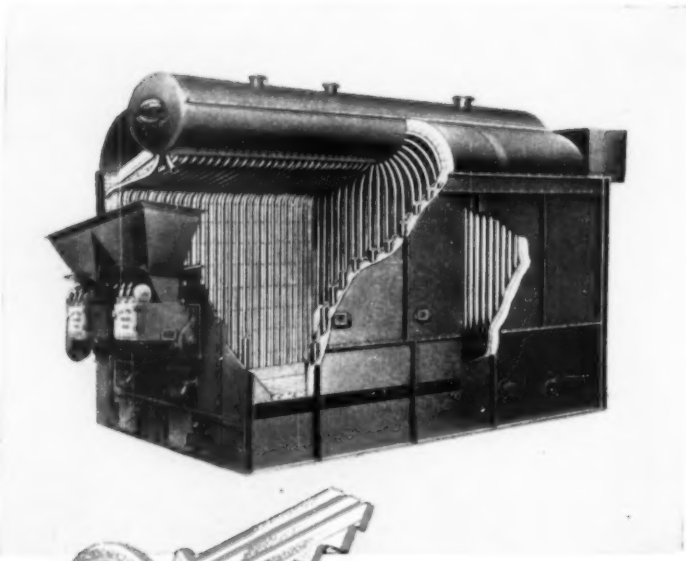
Field service engineers of Hall Laboratories get to boss the bosses when the top executives make their regular visits to all of the district offices to maintain first-hand contact with field problems. On such trips, even travel time is utilized for the exchange of information between the headquarters men and field engineers. When J. N. Welsh, Associate Director of Hall Laboratories, made the rounds of the western offices recently, one of his stops was at Nanaimo, where he presented a discussion on Steam Conditioning at a meeting of the Nanaimo Branch of the Institute of Power Engineers.

Water is your industry's most important raw material. Use it wisely.

ERIE CITY

ERIE CITY
114 Years in Steam Generation





TYPE "C"

Three drum boiler—larger water and steam holding capacity; internal baffles extremely simple; unique method of steam take-off eliminates moisture carryover while producing 8° to 14° F. superheat.

TYPE "VL"

Two drum boiler — designed for shop assembly to eliminate much of the costly field brickwork. Completely water cooled furnace keeps maintenance to a minimum. Headers are accessible through handholes from outside of the setting.

has a key to the solution of your steam problem—

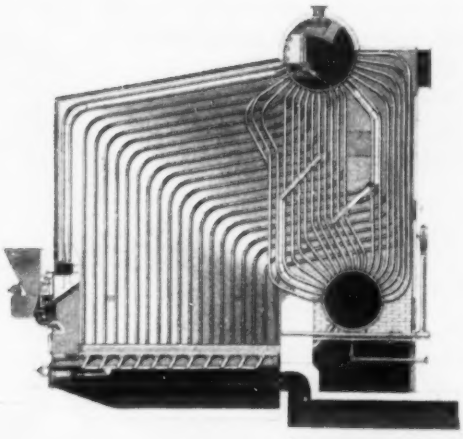
The keys are Erie City's complete line of steam power plant equipment, coupled with sound engineering. Here we show just four of the accepted designs of steam generators which can be adapted to your needs. Each has inherent advantages for large industrial, processing, or institutional steam demands.

Which design should you use? That's where Erie City Engineers apply sound engineering principles — offering you the most economical solution, consistent with high efficiency, and utilizing to the best advantage facilities and space. General Catalog SB-50 illustrates the complete line of products.

You can depend on Erie City for sound engineering

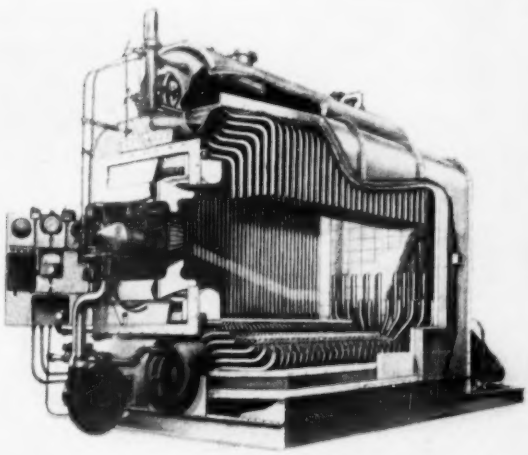
ERIE CITY IRON WORKS • ERIE, PA •

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS



TYPE "VC"

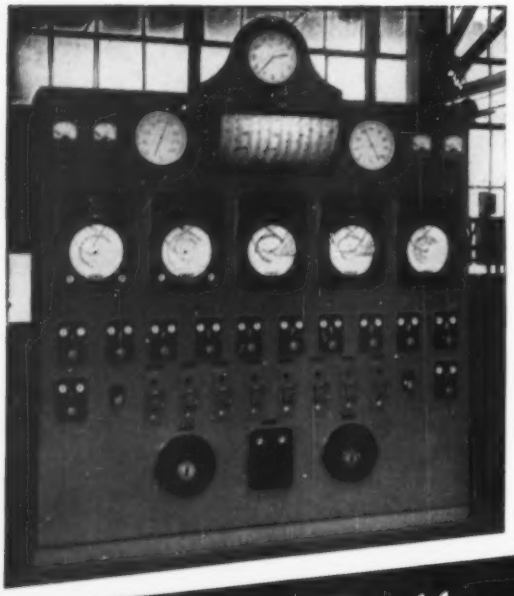
Modern two drum boiler modified from a basic design to include a completely water cooled furnace as an integral part of the main circulation system. This water cooling eliminates heavy refractory linings, reducing installation costs. Contact type steam scrubber assures high quality steam.



TYPE "K"

Package steam generator complete with all combustion and safety controls, burner and fan; mounted, piped and wired on a common base for easy field installation. FACTORY FIRE TESTED using specified fuel and duplicating actual field conditions.

For more data circle 506 on Post Card



This Bailey Boiler Control Panel in a mid-western industrial plant saves fuel and insures safe operation of a 100,000 lb per hr, 175 psi, sat., pulverized coal and gas-fired boiler.

What's Your Control-Dollar Efficiency?

Control-dollars frequently bring annual investment returns of 100% or more. When you buy adequate, well-applied steam plant controls, you increase your dollars' ability to work usefully for you.

That's where Bailey can help: Bailey Controls can give you a better control-dollar efficiency. Here's why:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service — conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better control-dollar efficiency—for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-112-1

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

For more data circle 510 on Post Card

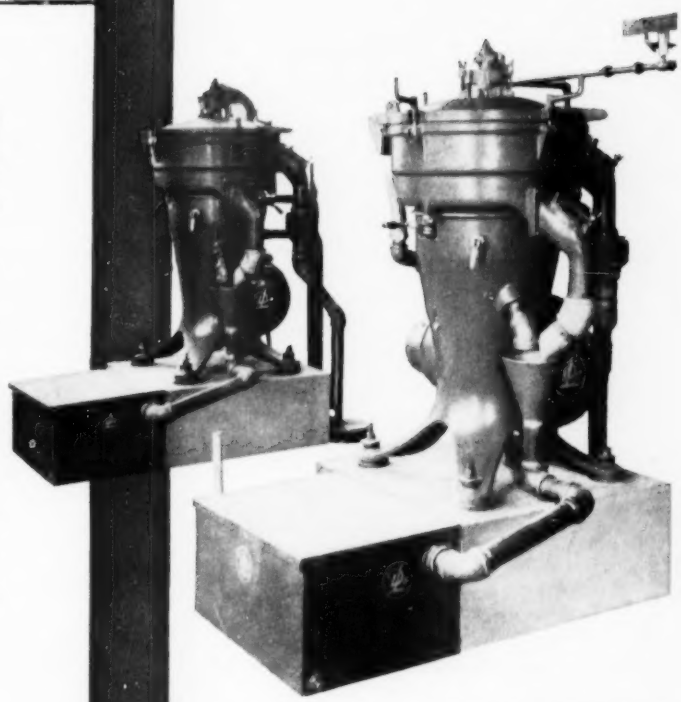
WHY MORE DIESELS ARE RUN ON RESIDUALS PURIFIED BY DE LAVAL

The main reason is cost-cutting . . . considerable savings in your plant. Because heavy fuels are much cheaper than light distillates . . . and most diesel engines can be easily converted to burn these residuals, give you a sizeable economy.

De Laval Purifiers take all the problems out of purification — they prepare the fuel properly . . . remove the maximum of incombustible solids and ash at *constant operating speed and efficiency.*

If the oil can be pumped, De Laval can purify it! Right now, De Laval Purifiers are handling oils having viscosities between 5000 and 6000 SSU at 100° F — in plants from coast-to-coast. Oils of greater specific gravity than water are also being purified.

Write for all the details . . . today. Your plant profits can be increased with De Laval Heavy Fuel Purifiers! . . .



TYPICAL PURIFYING RESULTS

	Unpurified Oil	Purified Oil
Specific gravity at 60°/60° F.	0.968	0.968
Viscosity SSU at 100° F.	5000	5000
Viscosity SSF at 122° F.	225	224
BS&W per cent by volume	0.60	0.20
Water by distillation, per cent by wt.	0.04	Trace
Ash at 550° C., per cent by wt.	0.045	0.021
Sediment by hot extraction	0.063	0.008

DE LAVAL

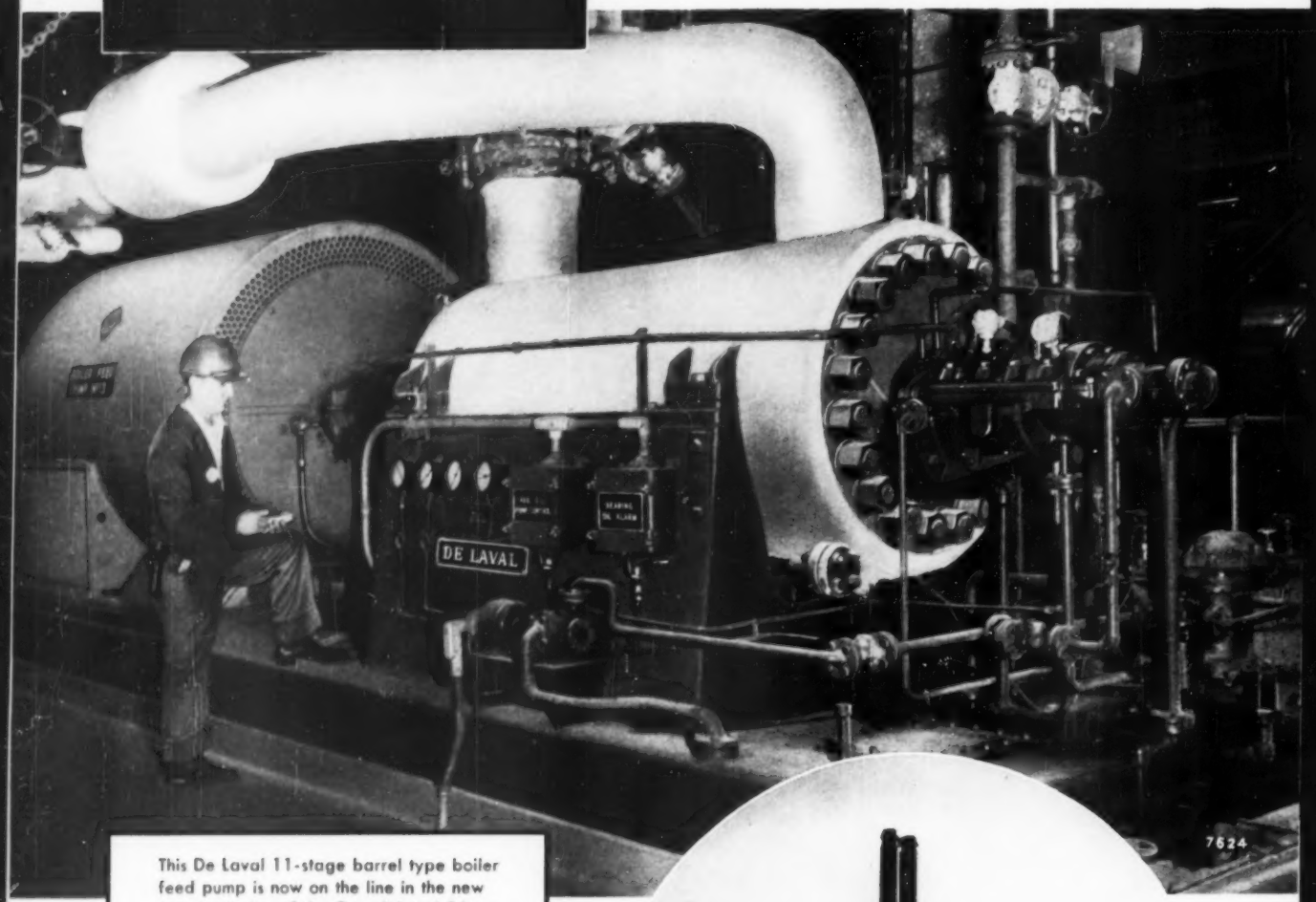
heavy oil purifiers

THE DE LAVAL SEPARATOR COMPANY Poughkeepsie, New York • 427 Randolph St., Chicago 6 • **DE LAVAL PACIFIC CO.** 61 Beale St., San Francisco 5

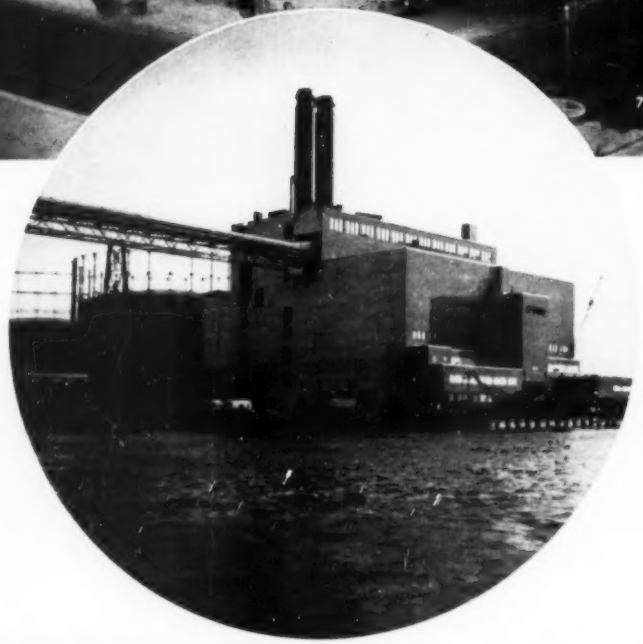
For more data circle 511 on Post Card

DE LAVAL
BARREL-TYPE BOILER FEED PUMP

in new Con Edison *Astoria power station*



This De Laval 11-stage barrel type boiler feed pump is now on the line in the new Astoria station of the Consolidated Edison Co. of New York.



The De Laval 8/6 pump operates at 129 psig suction pressure and delivers 1,570 gpm of 344 F water against 2,229 discharge pressure. Direct-connected at the end of the boiler feed pump shaft is a De Laval IMO pump for lubrication of the main pump and motor bearings. Also furnished is a motor-driven De Laval IMO auxiliary oil pump with pressure controlled switches. De Laval barrel type boiler feed pumps meet all the requirements of high pressure, high temperature boiler feed service. The distinctive De Laval design assures years of reliable operation with minimum maintenance.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

816 Nottingham Way, Trenton 2, New Jersey

DL-387

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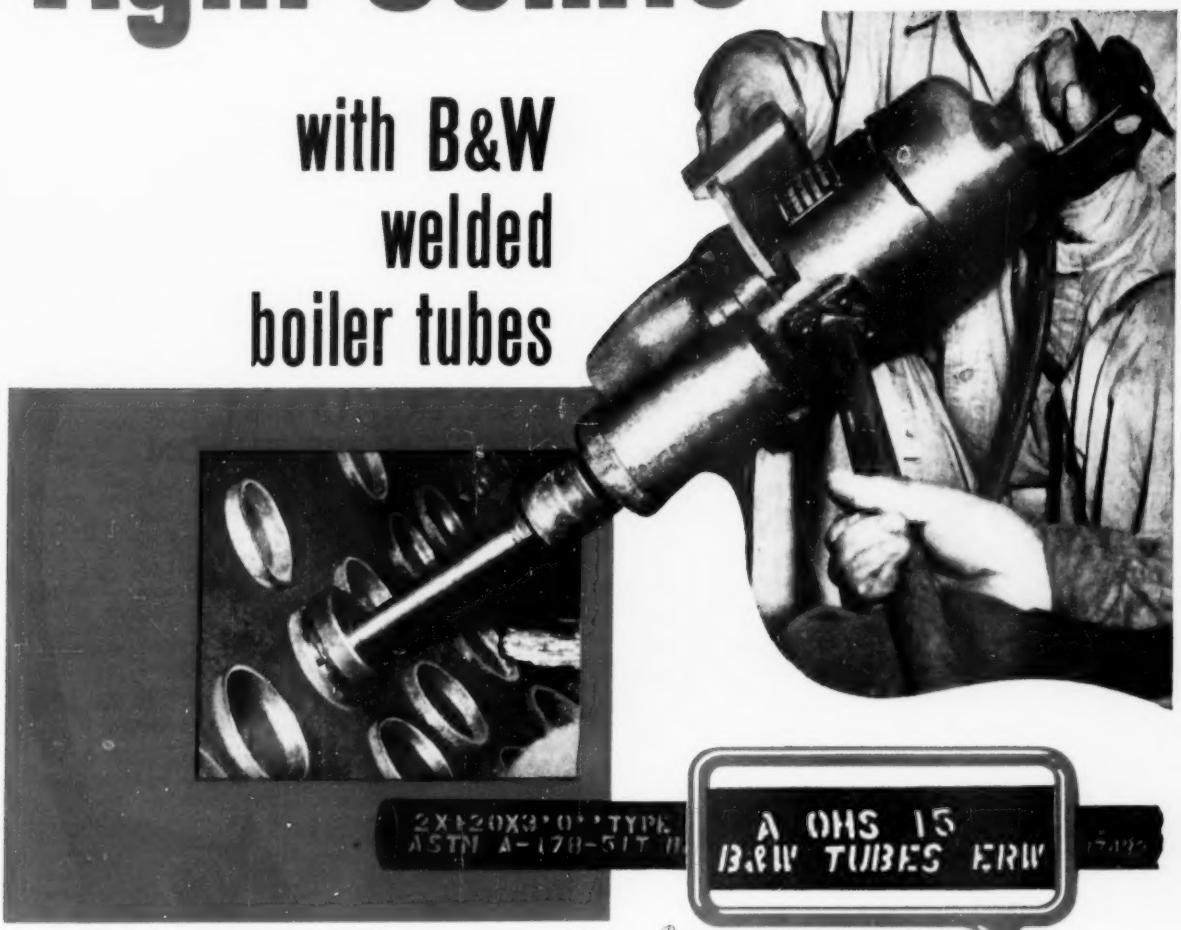
you get

Tight Joints

with B&W welded boiler tubes



A combination of qualities are offered by B&W Electric Resistance Welded Boiler Tubes that add up to savings in time, money and labor. The surfaces are free from pits, indentations, mill scratches and similar imperfections. Because of controlled normalizing practice, the surface is protected against formation of detrimental scale. This freedom from detrimental scale combined with uniform size and mechanical properties guarantees ease of "rolling in" and produces the tightest possible joint.

For three-quarters of a century, B&W has been directly concerned with developing and applying boiler tubes for all pressures up to those approaching 3000 psi. The application of this extensive knowledge and experience results naturally in the production of finer welded boiler tubes.

If you want ease of fabrication and long service life for the tubing in your boiler—specify B&W ERW Boiler Tubes.

LOOK FOR THIS

—wherever fine boilers are operating efficiently over extended periods. To meet the specifications of time; say B&W before you say WELDED BOILER TUBES — for service-proved dependability.

TA-4028(CWP)

B&W SEAMLESS and WELDED TUBES

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

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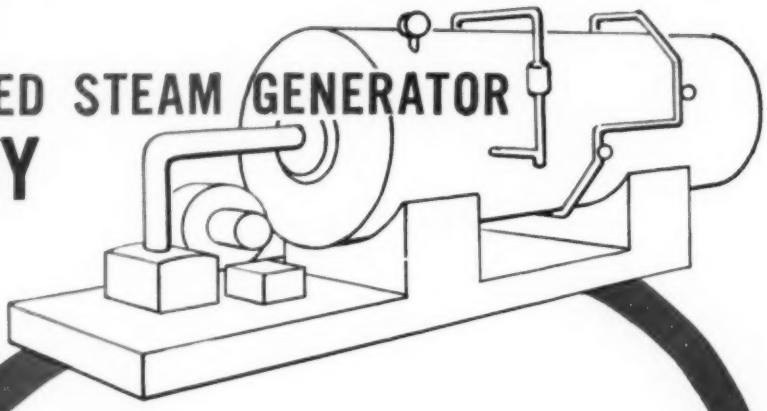
Ideal Combination

FOR TOP SELF-CONTAINED STEAM GENERATOR EFFICIENCY



1

Nalco WATER TREATMENT
SCALE AND CORROSION PREVENTION

With a Nalco Service Policy and Nalco Chemicals to fit your water treatment requirements, you can keep your self-contained boilers operating indefinitely at top efficiency — without any of the costly difficulties caused by scale and corrosion. This part of the Nalco System was designed expressly to provide small boiler users with the same complete water treatment services enjoyed by thousands of the country's largest power plants. A new 4-page bulletin gives complete details on The Nalco System as applied to the modern self-contained boiler. Your copy will be sent promptly, without obligation.

Write for Bulletin 49

2

Nalco SR-155 FUEL OIL ADDITIVE
FUEL SAVING . . . CLEAN BURNERS

Nalco SR-155 is a *complete* fuel oil additive. It replaces two, three or more single-purpose additives to: (1) keep storage tanks, fuel lines and burners free of sludge and gum; (2) prevent soot formation in the firebox and flues; (3) inhibit corrosion throughout the fuel system; and (4) act as a combustion catalyst to assure complete burning of oil. Fuel savings and reduced maintenance costs usually more than repay the cost of continuous SR-155 treatment — and very little SR-155 is needed per 1,000 gallons of fuel oil! Details on Nalco SR-155 will be sent on request.

Write for Bulletin 46

NATIONAL ALUMINATE CORPORATION
6224 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco® SYSTEM • Serving Industry through Practical Applied Science

For more data circle 514 on Post Card

HELPFUL BULLETINS

The new and revised publications reviewed on these pages offer help on many operating and maintenance problems. To order them, use the Reader Service Cards on pages 113-114

HEATING, VENTILATING

101 Heating, Ventilating Equipment — Revised Bulletin PB-290, 36 pp, describes and illustrates a line of heating, air conditioning, ventilating and heat transfer equipment. All new products, as well as existing ones with improvements are covered by text and illustration — although full information is not given on each product. Bulletin shows new large size CenTraVacs, cold generators, duplex compressors, Climate Changers, Delta-Flo fin coils, other equipment. The Trane Co.

102 Heating Units — Catalog 703, 24-pp, contains detailed description, photos, specifications, construction and application information on company's line of convectors. Floor, wall, front outlet wall, recessed and partially recessed cabinets plus sloping top models, are described with their accessories. Tables and charts show capacities. Airtherm Mfg. Co.

103 Hot Water Heating — Bulletin 1551, 16-pp, contains photos, application drawings and all necessary catalog information on the company's line of hot water equipment including circulators, valves, fittings, specialties and controls. Diagrams installations. C. A. Dunham Co.

VALVES, TRAPS, PIPING AND ACCESSORIES

104 Needle and Globe Valves — This pamphlet describes company's line of bellows seal needle and globe valves. Includes information on service, service range, sizes available, connections, materials, and special features. Diagrams and charts on dimensions are provided. Associated Valve & Engineering Co.

105 Air Release Valves — Bulletin 654 describes three styles of air release valves used for venting air from hot water heating systems, water mains, tanks in both deep and shallow well pumping systems, water filters and systems in water works, and for releasing air or gas from other liquid lines and tanks under pressure. Included is a capacity table showing cu ft of free air handled at different operating pressures; weights, prices. The V. D. Anderson Co.

106 Solenoid Valves — Bulletin 8210A features company's line of two way solenoid valves for controlling the flow of air, gas, water, light oil, and other noncorrosive fluids. Cutaway photos and diagrams illustrate design, construction, and application details. Includes flow charts and lists maximum pressures. Automatic Switch Co.

107 Thermostatic Traps — Repair Parts Catalog RTT-554 illustrates and describes company's line of thermostatic traps. Includes photos of the parts, specifications, and a list of company prices. A table of instructions for servicing is appended. Hoffman Specialty Mfg. Corp.

108 Stainless Piping — Of interest to power engineers associated with problems involving stainless piping, Bulletin TB 356 outlines methods of bending and joining stainless pipe and discusses light wall versus heavy wall type. Also included are a table of dimensions and weights of various stainless pipe size schedules and condensed technical data on mechanical and physical properties of the more popular stainless steels used for piping. Tubular Products Div., The Babcock & Wilcox Co.

109 High Temp Compound — This folder describes Thred-Gard, a high temperature compound designed to eliminate seizing and galling and lubricate threaded surfaces. Tells its use as thread lubricant and in other applications in power plants, refineries and chemical plants, steel mills, others. Crane Packing Co.

ELECTRICAL EQUIPMENT

110 Generator Voltage Regulators — Company's "rocking contact" generator voltage regulators are illustrated and described in two 12-pp bulletins. Booklet 3090 contains technical descriptions of regulators designed for small and medium-size a-c generators rated from 20 to approximately 438 kva. Booklet 3095 describes a regulator for medium and medium-large a-c generators designed for use in regulating the voltage of generators 438 to 1175 kva. Brown Boveri Corp.

111 Electrical Insulation — Three descriptive sample folders introduce a new series of composite asbestos electrical insulations recently added to the Quinterra and Quinorgo line. The folders contain samples for testing and experimentation plus descriptive information covering application, packaging, physical and electrical properties and pyrolysis resistance. Folder EL-54A covers Quinterra type 3-GR, a Class H electrical insulation for operating temperatures to 250 C. Folder EL-49A covers Quinterra type 5-GR and type 5-GL. These are Class B purified asbestos electrical insulations for temperatures to 150 C. Folder EL-55A covers Quinorgo 4000-GR and 4000-GL, economical Class B purified asbestos insulations. Johns-Manville.

112 Reducing Effective Bandwidth — How to increase a feeder's length or load carrying ability, gain revenue and reduce customer's complaints is explained in Booklet GED-2235, a 20-pp publication using simple diagrams and examples. It is essentially a discussion of how feeder voltage regulators with control accuracy reduce feeder's effective bandwidth. General Electric Co.

113 Switch Wiring Diagrams — Bulletin 709 is a 36-pp booklet of typical wiring diagrams for across-the-line starting switches. Indexed and arranged for easy use, this booklet serves as a guide to some of the many ways in which this company's manual and magnetic across-the-line starters can be applied. Some of the diagrams incorporate more than one useful feature. Includes key to electrical symbols used. Each diagram is accompanied by brief explanatory text. Allen-Bradley Co.

114 Solenoid Contactors — Bulletin SC-9, 8 pp, features a wide range of enclosed and sealed solenoid contactors with power ranges to 250 amp. Bulletin includes dimensional drawings and complete technical data. Lists military specification numbers, type numbers and specific approval information. Guardian Electric Mfg. Co.

115 Commutator Motors — Catalog E1-2A, 24-pp, describes company's line of commutator type motors. General physical specifications and construction details are included. Typical performance curves are plotted and numerous diagrams illustrate frame dimensions. Electric Indicator Co., Inc.

116 Batteries for Control, Switchgear — This company's PlastiCal (lead calcium) and PlastiCell (high-tensile alloy grid(batteries for control, switchgear, and auxiliary power are described as to design, application and performance in Bulletins CP-536 and CP-537. Specifications and dimensional data are also included. C & D Batteries, Inc.

117 Fittings and Fixtures — Catalog 55 is a 72-pp ordering book covering a line of conduit fittings, plugs and receptacles, lighting fixtures, safety switches, circuit breakers and floodlights. Fully illustrated and indexed, includes prices, suggestions for use. The Pyle-National Co.

118 Electrical Ceramics — This pamphlet contains a large chart which lists electrical and mechanical properties of company's standard grades. Along with such properties as water absorption, density, tensile strength, dielectric constant, volume resistivity, and others, it recommends various general applications for all grades. General Ceramics Corp.

WATER CONDITIONING

119 Water Conditioning Equipment — Bulletin 6210 is an illustrated condensed catalog covering company's line of demineralizers; hot process, hot lime zeolite and zeolite softeners; reactors; deaerators; dealkalizers; filters; continuous blowoff systems; control and relief valves; separators; purifiers, and other equipment. Includes references to more detailed booklets available on the various products. Cochrane Corp.

120 On Process Water — The value of a broad approach to industrial water problems through an overall survey of process water is outlined in this 6-pp folder. Gives examples of how a process water survey to find out how water is being used — or wasted — in a plant can

have some or all of the following benefits: conservation of critical materials, reduction of water use, and savings in wastewater treatment. Hall Laboratories, Inc.

121 Pressure Filters — Company's line of filters and accessories, used to remove suspended solids such as dirt, turbidity, iron, oil and color, is described in comprehensive and well documented Bulletin 2225B, of special interest to power engineers with water problems. Specifications, operating characteristics, outline dimensions and typical installation photos are included. The Permutit Co.

SAFETY, FIRE PROTECTION

122 Flame Failure Protection — Sixteen-pp Fireye Bulletin CF-30 describes a system for protection against explosion hazards of burning fuel in light oil, gas, and combination oil/gas burners. Lists specifications and gives installation and application details. Many diagrams help to illustrate construction and operation of the system. Includes diagrams on mounting dimensions, installation wiring, programming sequence, internal and external wiring, and cam and relay contact identification. Relay operation is explained and details on installation testing and servicing provided. Combustion Control Div., Electronics Corp. of America.

123 Fire Extinguishing System — A pressure-operated CO_2 fire extinguishing system which employs thermostats at the fire hazards to detect fire and release the extinguishing system is the subject of this 11-pp bulletin. It includes many diagrams which illustrate design and operation features. Walter Kidde & Co., Inc.

124 Fire Hose and Fittings — This 8-pp catalog covers company's line of industrial fire hose and fittings. Includes construction details and illustrations of the complete line of fire and suction hose, extinguisher tubing, and fire hose couplings. Lists specifications for each type of hose as to size, weight, construction, and recommended use and working pressures. Boston Woven Hose & Rubber Co.

INSTRUMENTS AND CONTROLS

129 Miniature Instruments — Twelve-pp Bulletin 7201 describes and illustrates company's quick-connect Tel-O-Set miniature recorder and controller. Details on the design of the instruments and their operation are provided and schematic diagrams and specifications are included. Minneapolis-Honeywell Regulator Co.

130 Control and Telemetering Instruments — Twelve-pp Bulletin DMO35 lists and illustrates recording automatic controlling, and telemetering instruments. Features new line of Metagraphic pneumatic transmission instruments, which divide functions of measuring, recording, and controlling into three separate instruments to achieve maximum flexibility in application. Illustrates and describes briefly the full line of recorders and controllers for temperature, flow, liquid level, mechanical motion, running time, count, operation and speed. Includes electric and electronic instruments for measuring current, voltage, power, and other variables which can be translated into electrical quantities. The Bristol Co.

131 Automatic Regulators — Illustrated information on 12 basic control valve types used in chemical process industries, power generating facilities, and in liquid or gas pressure control applications requiring precise instrumentation by automatic regulators is presented in this bulletin. Reducing valves, pump governors, relief valves, temperature regulators, float valves, damper regulators, combustion control valves, and boiler feed-water regulators are included. Atlas Valve Co.

132 Guide to Rotameters — Bulletin 110b includes general data on various models of company's rotameters and describes their operation and application. Offers specifications on indicators and transmitting extensions, Flowmizers — low cost meters for noncorrosive services — and on laboratory kits available for research and pilot plant applications. Meters for low and high pressure flows are also described. Brooks Rotameter Co.

133 Improved Flow Meter — Catalog 5001 shows construction of the Critiflo-Meter for measurement and control of steam and gases. Outlines operating principle, explaining how flow is indicated by upstream pressure alone, regardless of fluctuations in downstream or process pressure. Various ways of applying the instrument are described, along with advantages. King Engineering Corp.

134 Temperature Control — Bulletin 104 features the Model D-18 temperature control, which operates by the differential expansion of solids and is designed for those installations where the temperature setting must be frequently and easily changed. Specifications and a diagram showing construction details are included. Burling Instrument Co., Inc.

135 Plug Valve Actuator — This 8-pp bulletin introduces a line of plug valve actuators for remote control of all types of wrench-operated plug valves from 1 in. to 8 in. Illustrated with photos of typical installations and detailed drawings, the bulletin gives complete engineering data and information on how the plug valve actuators are used. Includes ordering information. Pantex Mfg. Corp.

MECHANICAL POWER TRANSMISSION

136 Adjustable Speed Equipment — The principle and use of dynamatic eddy-current adjustable speed equipment are presented in 16-pp Bulletin GB-2. Includes company's complete line — Adjusto-Spede drives, liquid and air cooled couplings and brakes, Dynaspede stationary field couplings, dynamometers, and others. Outlines basic principles of eddy-current machinery, torque, heat and operating characteristics, cooling efficiency and control. Illustrated with photos of equipment and typical applications. Dynamatic Div., Eaton Mfg. Co.

137 Variable Speed Drives — Illustrated Bulletin 497 introduces a single wide-range belt variable speed drive. Shows how to design and select drives for 1- to 20-hp motors. This drive is described as extremely simple, yet covering a wide range of horsepowers with ratios up to 3 to 1. Bulletin includes dimensions and prices. T. B. Wood's Sons Co.

138 Porous Bronze Bearings — More than 600 of the most widely used sizes (including standard sizes) of oil-retaining porous bronze bearings are listed by size in company's 20-pp Stock List 4. Based on the most popular stock sizes produced by the company, this list has been prepared to save the user time by eliminating sizes infrequently used. In addition to listing sizes of flange, sleeve and thrust bearings, together with cored and solid bar stock, it provides condensed information on application, installation, lubrication and machining. Bound Brook Oil-less Bearing Co.

HEAT EXCHANGERS AND CONDENSERS

140 Heat Exchangers — A description of stock and specially engineered fixed tube bundle heat exchangers is given in newly revised 12-pp Catalog 1254. Contains application photos covering a wide range of industries and includes materials and construction features, dimensional drawings, tables. Approximately 4 pp are devoted to a guide to heat ex-

. . . *Outstanding Among This Month's Catalogs* . . .

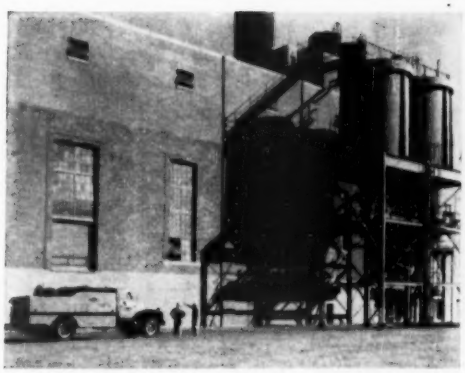
125 Good Operating Practices — Some 101 good suggestions for maintaining plant buildings and equipment are presented in the 12-pp new edition of this booklet. Well illustrated, contains latest recommendations for getting the best service out of insulations, packings, refractory products, roofings and friction materials. Johns-Manville.

126 Fuel Oil Heaters — Bulletin 743, 20-pp, covers a line of fuel oil heaters, giving detailed information on dimension, capacities, and installation. Contains tables and diagrams describing each model. In addition, includes tables which aid in selecting correct fuel oil heater for any heavy oil burning installation. A section of catalog is devoted to a quiz in which pertinent questions on fuel oil heating problems are asked and answered. Manning & Lewis Engineering Co.

127 To Test Your Cooling Tower — This 20-pp booklet describes a simple, direct method by which a power engineer can assure himself that the performance purchased is the performance a cooling tower delivers. The method outlined is said to be simpler, more direct and more conclusive than previous methods and requires a minimum of apparatus and effort. Every step has been checked in hundreds of applications and the results are said to be conclusive when applied to large industrial towers. The Marley Co.

128 Surface Condensers — Data and technical information on problems of power plant engineering are contained in 20-pp Bulletin 19B-8201 on the proportioning of surface condensing equipment. Tells about surface condensers, how they operate, their nomenclature and definitions. Describes factors entering into the proportioning and selection of surface condensers, provides formulae for use in calculating condenser performance, and carries a variety of curves and tables. Also includes information on chemical composition of tubes and recommended proportions. Allis-Chalmers Mfg. Co.

300,000 PPH BOILER CLEANED CHEMICALLY IN ONE DAY!



Dowell engineers bring solvents to the job in truck-mounted tanks, along with all pumping and control equipment. They apply the chemicals as necessary—by filling, spraying, jetting, cascading or vaporizing.

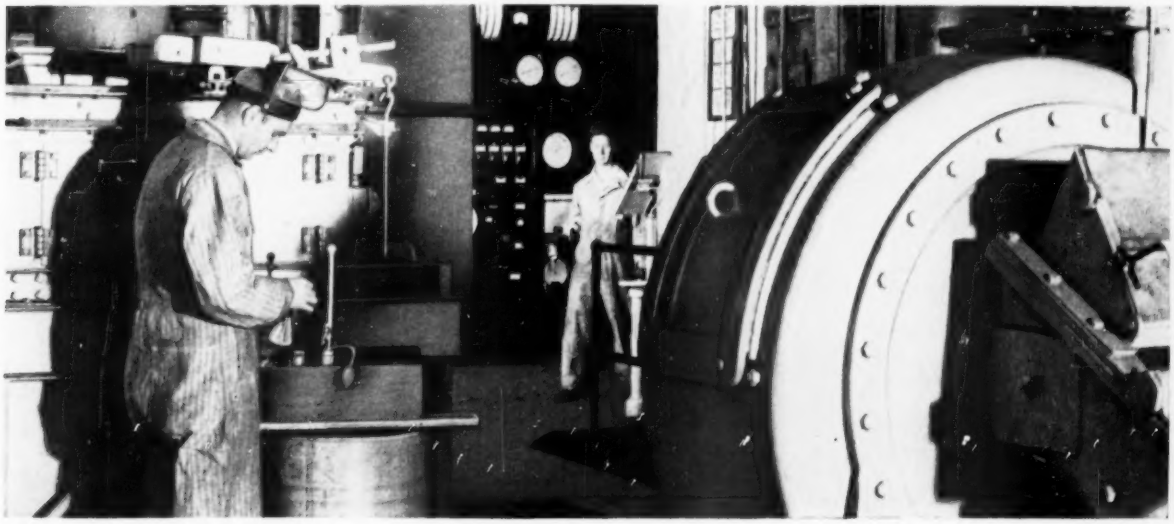
Comparative cases showed DOWELL cleaning took less time . . . removed more scale than mechanical methods

This is a case history on a 300,000 pound per hour boiler in a refinery. A routine inspection showed that iron oxide and silicate scale fouled the tubes. Dowell engineers cleaned the boiler with chemical solvents in less than 22 hours.

Dowell chemical cleaning is the standard method of removing deposits from boilers in this plant. Comparative tests showed that the chemical method was both faster and more thorough than the mechanical means previously used. The operator was surprised at the relatively large amounts of scale and sludge removed by chemical cleaning. Dowell has cleaned 25 of the 27 boilers in this plant. Several have been cleaned as many as three times on an annual basis.

Dowell liquid solvents go wherever steam and water flow, reaching surfaces inaccessible to other methods. No special scaffolding is required. *Dismantling and down-time are kept to a minimum.* Often, equipment may be cleaned while in operation.

Perhaps chemical cleaning could improve the efficiency of equipment in your plant—for example, heat exchangers, piping systems, tanks and process towers. For complete information and estimates, call the nearest of more than 130 Dowell offices, or write directly to Dept. L-24, DOWELL INCORPORATED, TULSA 1, OKLAHOMA.



DOWELL SERVICE

chemical cleaning service for industry

DOWELL

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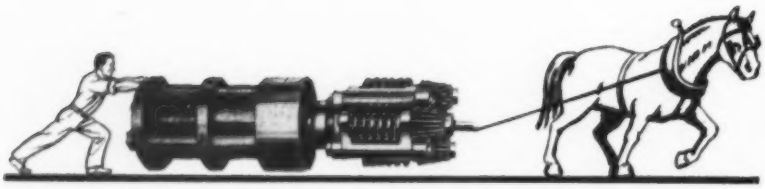

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Even if you rarely use tube cleaners, you can't afford to be without a powerful new ROTOJET. A ROTOJET should save you enough in time, labor, and air in one cleanout to pay for itself. You won't believe a tube cleaner can pack such tremendous power until you try the new ROTOJET.

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ELLIOTT COMPANY-ROTO DIVISION

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For more data circle 516 on Post Card

changer selection. This data includes tables and formulas for selecting exchangers involving the most common cases of water-to-water and water-to-oil heat transfer. Young Radiator Co.

141 Large Capacity Condenser — Bulletin 123 describes the 400-ton capacity Aeropass condenser and fluid cooler. Explains and illustrates operating principles of the unit. Lists benefits offered for large liquid cooling and condensing applications. Niagara Blower Co.

REFRACTORIES

142 Refractory Selection — Prepared mainly as a review of practical refractory problems and their solution, this 12-pp booklet also discusses nomenclature generally applied to the various classes and types of granular refractories, outlining their characteristics and properties. Applications on both open hearth and electric steelmaking furnaces are covered, as well as gunning and ramming techniques. Basic Refractories, Inc.

143 Refractory Grain — Form 1741, a 24-pp bulletin, discusses properties of Alundum fused alumina, Crytolon silicon carbide, Magnorite fused magnesia, fused zirconia, and Norbide boron carbide. Technical information about these products includes melting points, electrical properties, physical characteristics, typical analysis, grain sizes available, present and possible future applications, graphs, tables and technical charts. Norton Co.

FANS, BLOWERS

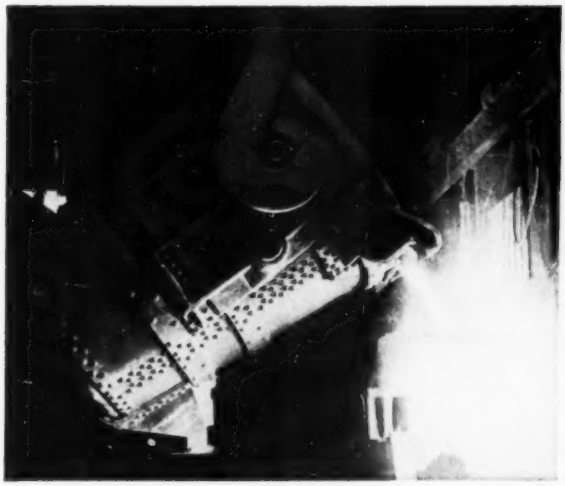
144 Industrial Exhaust Fans — Twenty-pp Catalog 500-B describes exhaust fans for use in connection with pneumatic conveying systems handling many kinds of bulk materials. Covers various applications, types and construction. Complete dimensional data and capacity tables are provided. Principles of application and engineering data for standard and long-cone cyclone separators are described and illustrated. Fort Worth Steel and Machinery Co.

145 Fans for Air, Materials Handling — Bulletin 702 introduces company's Type XL fans for industrial air and materials handling applications. Illustrated, presents design and operational details on these large fans. Includes general data, also performance data at other than standard conditions. Clarage Fan Co.

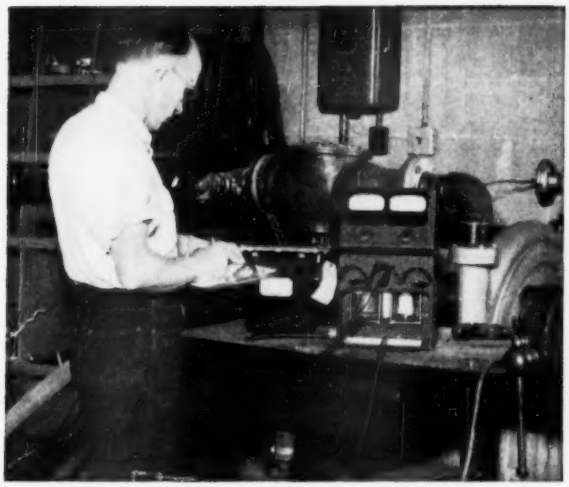
WELDING

147 Welding of Stainless Tubular Products — Technical Data Card 162 outlines welding characteristics of both austenitic and ferritic grades of stainless steels and discusses the question of proper joint design. In addition, it briefly describes various methods such as: fusion, metallic-arc, oxyacetylene, atomic-hydrogen, inert gas arc and flash-butt welding. A table of recommended arc welding procedures is included which suggests electrodes, preheating and post-welding heat treatment. Tubular Products Div., The Babcock & Wilcox Co.

148 Preheating for Welding — This 8-pp illustrated article reviews welding procedures which have been found to produce crack-free joints under a variety of conditions. Includes basic guide to ferrous metallurgy, table of recommended preheat temperatures. Tempil Corp.



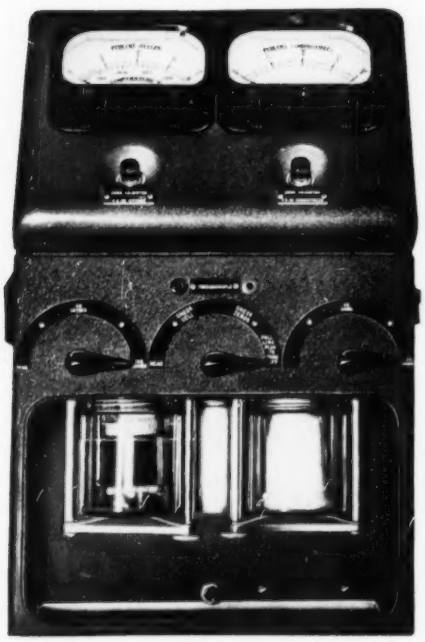
STEEL OUTPUT INCREASED BY 110 TONS PER DAY REPORTS STEEL PRODUCER: Tap-to-tap time reduced from 18 to 12 hours . . . Fuel cut 46% per ton produced . . . Tonnage up 50% daily! That's the job Cities Service Heat Prover helped perform for one of the largest steel producers.



"COMPLETED 30 HOUR TEST IN JUST 6 HOURS!" "We completed what normally would have been a 30 hour test in just 6 hours," writes the Eclipse Fuel Engineering Co. of Rockford, Ill. "We found the Heat Prover equally exact, perhaps more exact than standard commercial testing equipment."

INDUSTRY REPORTS ON FURNACE OPERATION:

PRODUCTION UP, COSTS DOWN WITH CITIES SERVICE HEAT PROVER



THE CITIES SERVICE HEAT PROVER . . . Not an instrument that you buy . . . but a service we supply . . . **FREE!**

Shown above are just two of the many outstanding accounts of the Heat Prover's impressive accomplishments. Wherever a furnace operation is involved, the Heat Prover can help increase productivity by providing:

- **Rapid, continuous sampling**
- **Simultaneous reading of oxygen and combustibles**
- **Direct measurement of oxygen and combustibles**
- **Easy portability**
- **Free maintenance and re-calibration service**

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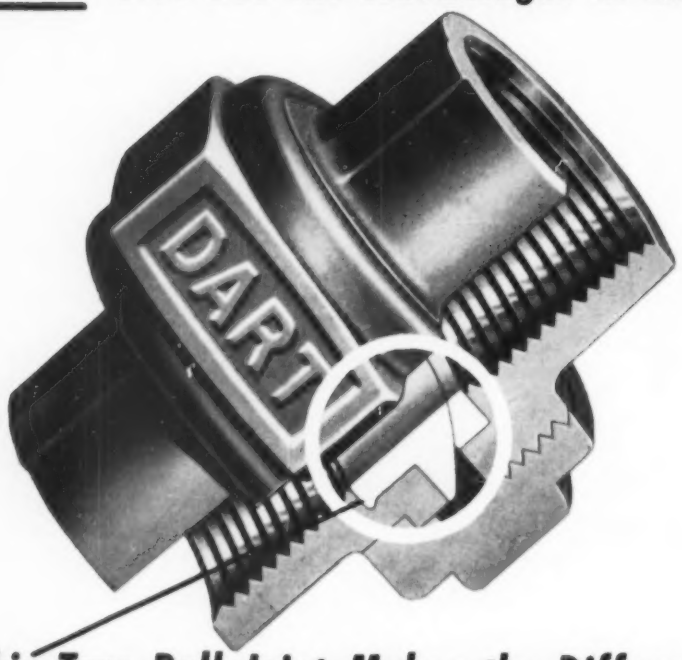
ALL-BRASS? ALL-IRON?

DARTS Give You the Advantages of Each!



This True Ball Joint Makes the Difference

Part malleable iron, part bronze alloy, Darts have the advantages of all-brass unions, without the disadvantage of stretching. They have the advantages of all-iron unions without the disadvantage of rusted or pitted seats. They're easy and fast to install, give a drop-tight fit, and can be taken off and used over and over again. You can't buy more for your union money!

QUICK FACTS

- ✔ Leakproof because precision-machined to a true ball joint and spherically ground
- ✔ Shoulders are heavy — withstand abuse
- ✔ Each Dart is individually vacuum-tested
- ✔ Bronze alloy seats are extra wide, resist pitting and corrosion
- ✔ Practically indestructible Nut and Body . . . of air-refined, high-test malleable iron

DART

UNIONS

DART UNION COMPANY • PROVIDENCE 5, RHODE ISLAND

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METALS AND ALLOYS

149 Super Alloys — This 20-pp brochure describes and gives the physical properties and processing data on super alloys — high strength heat and corrosion resistant materials. Included in the pamphlet are notes on the uses and characteristics of some super alloy grades, tables and charts illustrating the properties of these materials, and forms available. Universal-Cyclops Steel Corp.

150 Heat-Resistant Alloy — A new high temperature alloy, NA22H, is the subject of this 4-pp folder. Various uses of the alloy, which will withstand operating temperatures up to 2200 F are described. Includes chart which compares high temperature properties of NA22H and other heat resistant alloys. National Alloy Div., Blaw Knox Co.

151 Alloy Sheathing — Technical Bulletin 205-A discusses possibilities of tellurium alloy as a sheathing material, based on extensive tests of the material under various physical conditions. Includes photos and graphs showing results of tests. John A. Roebling's Sons Corp.

OTHER EQUIPMENT

152 Combination Burners — Bulletin 176 describes and illustrates fully automatic oil-gas burners of the horizontal rotary-nozzle mix type designed to permit instant change from one fuel to another. Gives design details and electrical characteristics, includes specifications. Also presents an extension front for conversion installations. Preferred Utilities Mfg. Corp.

153 Wheel Tractor — Features of company's Model WD-45 wheel tractor equipped with backhoe and other hydraulically operated attachments, are outlined in 8-pp Catalog MS-982. In addition to specifications, catalog includes illustrations of basic unit and of the various front and rear-mounted attachments; a cutaway view of the tractor's powerline; pictures of the 45 hp "Power-Crater" engine's replaceable wet cylinder sleeve. Tractor Div., Allis-Chalmers Mfg. Co.

154 Circulating and Coolant Pump — Form 7074-D, 20-pp, shows a line of Motorpumps with totally enclosed motors. Arranged for easy selection, a pictorial index helps to locate pages describing size and type of pump desired. Data provided includes performance curves, cross-sections, dimensions, descriptive material for each particular pump class. Horizontal and vertical units are described in fractional and integral horsepower sizes, as are cradle and flange mounted units meeting JIC standards. Ingersoll-Rand Co.

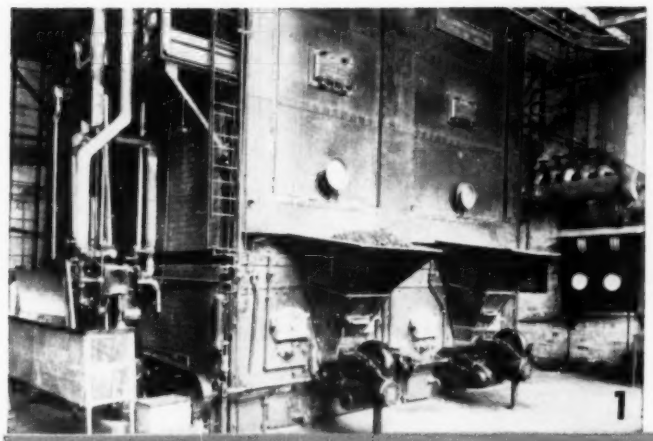
155 Internal Purifiers — An internal type purifier for delivering clean vapor and gases from steam drums, flash tanks, evaporators, packed towers, bubble-cap towers, deodorizers, and stills is described in Bulletin 103. Contains dimensional drawing illustrating the use of purifiers inside two typical installations, steam drums and bubble-cap towers. Also includes a cutaway drawing illustrating flow of vapor. The V. D. Anderson Co.

156 Automatic Lubrication — This bulletin covers three basic elements of automatic lubrication — lubricators, distribution systems, and meter-units. Illustrates eight types of automatic lubricators and describes a typical pump and reservoir assembly. Distribution system details are given, including information on variety

27 YEARS DEPENDABLE OPERATION

with Detroit Single Retort Stokers in the Cleveland Graphite Bronze Company

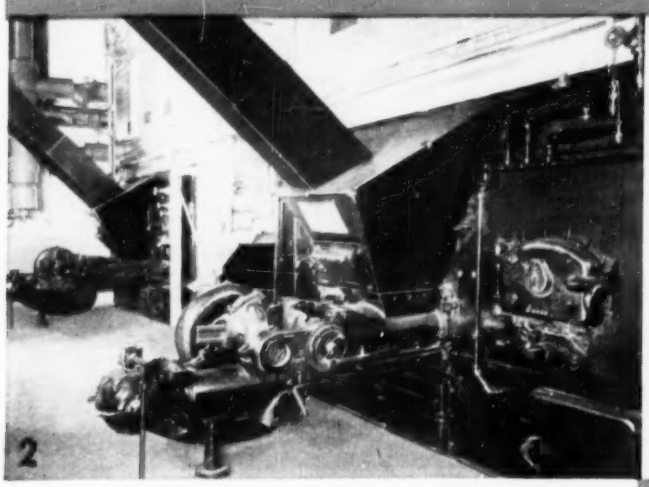
(Central Ave. Plant)



These old Detroit Single Retort Stokers have been operating for more than a quarter of a century and are still in excellent condition, giving satisfaction to the owners. Another typical example of Detroit Stoker durability.

Detroit Stokers are designed and built to outlast the boilers that they serve.

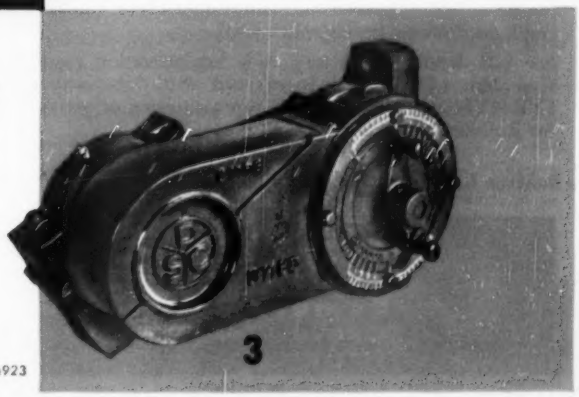
You can buy lower priced stokers but none that cost you less in the long run.



1. Steam engine driven Detroit Single Retort Stokers installed in 1927 at Cleveland Graphite Bronze Company Boiler Plant. Still giving efficient service.

2. Latest type Detroit Single Retort Stokers, individually motor driven, with Detroit Adjustable Feed Controls at Mumford High School, Detroit.

3. Detroit Adjustable Feed (Coal Feed Control) provides many rates of coal feed . . . is regulated either manually or automatically. Air supply from separate fan is properly proportioned to the coal feed for maximum efficiency at all capacities.



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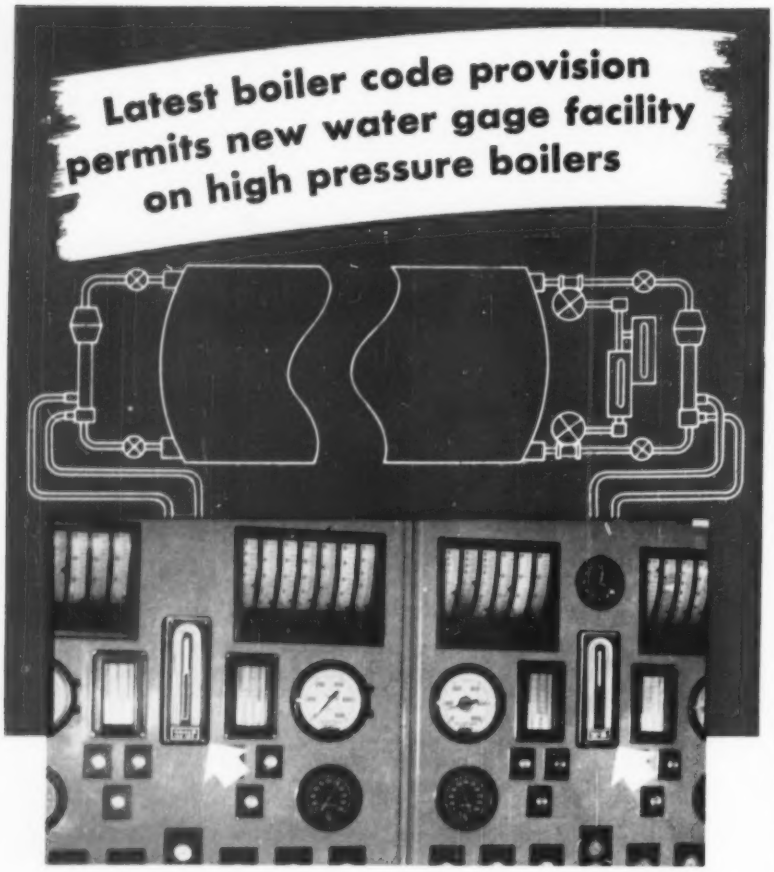
DETROIT SINCE 1898 STOKERS

6923

For more data circle 519 on Post Card



Now two EYE-HYE Remote Gages give you the required double check on pressures 900 lbs and over

Two independent remote level indicators of the compensated manometric type may now be used instead of one of two gage glasses required on pressures 900 psi and over. You still must have one conventional type gage, maintained in serviceable condition, but it may be shut off while both remote indicators are in operation.

This is a tremendous advantage. It removes the need for checking high gages, maintaining mirrors or other water level reading methods. EYE-HYE's sharp, illuminated indication is frequently reported as more accurate than gages at the drum. Now the two gages required can be at eye height—convenient, safe—a true double check on the vital boiler water level.

For full details of the new code interpretation read Case No. 1155. For information about Reliance EYE-HYE, call your Reliance representative or write for Bulletin CO.

The Reliance Gauge Column Co. 5902 Carnegie Ave., Cleveland 3, Ohio

For more data circle 520 on Post Card

of tubing, junctions and flexible hoses. A cut-away view shows internal construction. Bijur Lubricating Corp.

157 Engine-Generator Sets — Eight-pp Bulletin G-6 presents engines from 60 to 675 hp with generators capable of producing from 50 to 350 kw — custom built sets for dependable, low cost stand-by power. Drawings show basic dimensions and charts give maximum, intermittent and continuous horsepower. Le Roi Div., Westinghouse Air Brake Co.

158 Drainage of Revolving Dryers — Bulletin 266 explains fundamental principles of company's Syphon Scoop, used for draining cylinder dryers. Tests are described to show efficiency of the scoop in removing condensate from revolving dryers. Armstrong Machine Works.

159 Chemical and Processing Equipment — Blending, processing, and heat exchange equipment for the chemical and processing industries is described in 12-pp Bulletin 13. Provides photos and specifications on a variety of sizes and adaptations to company's three basic types of blenders. Describes process equipment in ranges from small 5 to 15 gal packaged pilot and autoclaves to kettles and reactors of 1000 gal capacity, with most equipment available in stainless steel. Twenty cooling and heat exchange units are shown. Patterson-Kelley Co.

160 Tube Expanders — Eight-page Bulletin Y-38 describes company's line of tube expanders for condensers and heat exchangers, and gives full data on how to choose the proper expander for each rolling job. Includes chart listing prices and dimensions. Also contains material on tube sheets, drive motors, acceptable practice, operating instructions and types of cleaners for small tubes. Lagonda Div., Elliot Co.

It's easy to get these free catalogs—just circle item numbers of those wanted on the two post cards provided on pages 113–114

161 Tubing Support System — Twelve-pp Bulletin 254 presents a system for permanent and continuous support of instrument tubing. All items and fittings are illustrated by photo or dimensional drawing. Details of actual installations show some of the methods by which this system can be quickly and economically erected at the job site. Instrof Inc.

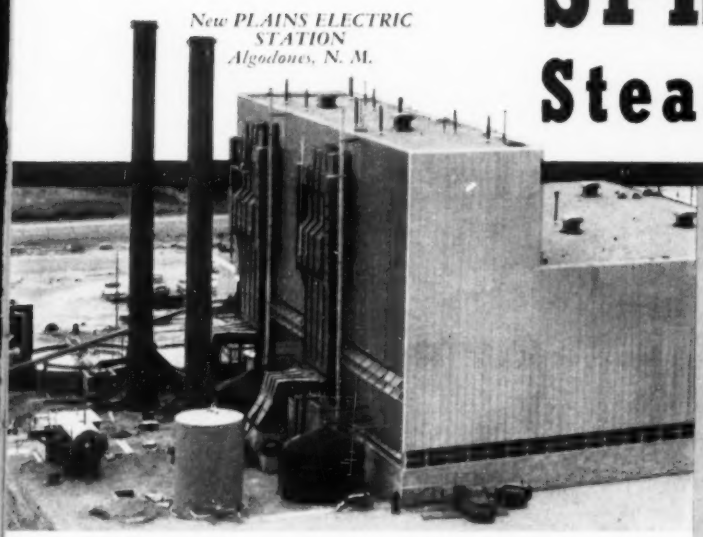
162 Facts on Machine Anchoring — Case histories on the use of this company's Unisorb for machine installations are told and illustrated in this 24-pp booklet. They cover metalworking plants, food processing plants, printing plants, others. Also included are test data on vibration and the use of felt as an isolation material. The Felters Co

163 Air and Gas Filter — The Dorfan Impingo Filter for cleaning hot, wet and corrosive gases and air is detailed in 8-pp Bulletin 4. Explains that the Impigno removes dust, dirt and impurities by passing gases through two or more cells containing moving granules. Included in brochure are a variety of installation photos, engineering drawings of filter components and complete systems, as well as descriptive data. Mechanical Industries, Inc.

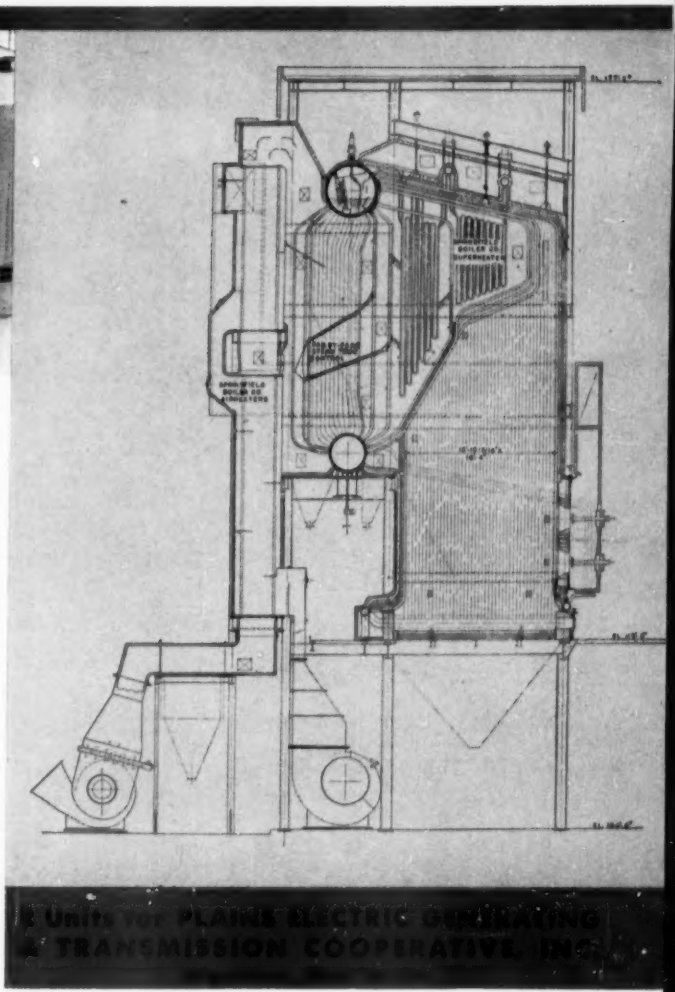
Another New Installation of

SPRINGFIELD

Steam Generators...



New PLAINS ELECTRIC STATION Algodones, N. M.



2 Units for PLAINS ELECTRIC GENERATING & TRANSMISSION COOPERATIVE, INC.

"Our project supplies electric energy to eleven of the seventeen distribution cooperatives in the state of New Mexico and to one in southern Colorado," writes Norton Davis, Manager, PLAINS ELECTRIC GENERATION AND TRANSMISSION COOPERATIVE, INC. *"This project was built with the primary idea in mind of supplying the much needed, economical electric power in the area served by our member distribution cooperatives. It, therefore, follows that a great deal of study was given to the selection of all major equipment with an eye to economy and reliability of operation."*

Numerous ingenious and advanced features are incorporated in the design of the Springfield Steam Generators furnished for the new Algodones, N. M., plant. In addition to automatic superheater temperature control, provision is made for control of flue gas temperature above dew point in airheater on low loads. The steam washer is of Springfield patented design and all provisions are made for future spreader stoker firing with economizer and dust collector ahead of I. D. fan, if desired. As shown in the above photograph, the generators are placed so that the unit rear walls form a portion of the building wall.

Find out about the broad range of service SPRINGFIELD offers—from small, standardized PACKAGE BOILERS to large, specially designed STEAM GENERATING UNITS. *Your inquiry will receive prompt attention.*

Continuous Steam Capacity, Each Unit	160,000 lb hr.
Maximum Steam Capacity (2-hr. peak) Each Unit	180,000 lb hr.
Boiler Design Pressure*	950 psig
Operating Pressure, at Superheater Outlet	875 psig
Final Steam Temperature (Controlled)	910 F.
Maximum Heat Release	29,900 Btu/cf/hr.
Heat Recovery:	Springfield Two-Section Tubular Airheater. Provisions for future Springfield Steel Tube Economizer.
Type of Firing	Gas and/or Oil (Future coal)
Installation	Semi-Outdoor

Consulting Engineer:
LARAMORE and DOUGLASS, INC.
Chicago, Illinois

Worldwide Sales and Service
SPRINGFIELD BOILER CO.
FOUNDED IN 1890
DIVISION OF *John W. Hobbs Corporation*
1951 E. Capitol Avenue • Springfield, Illinois
See our catalog in SWEET'S

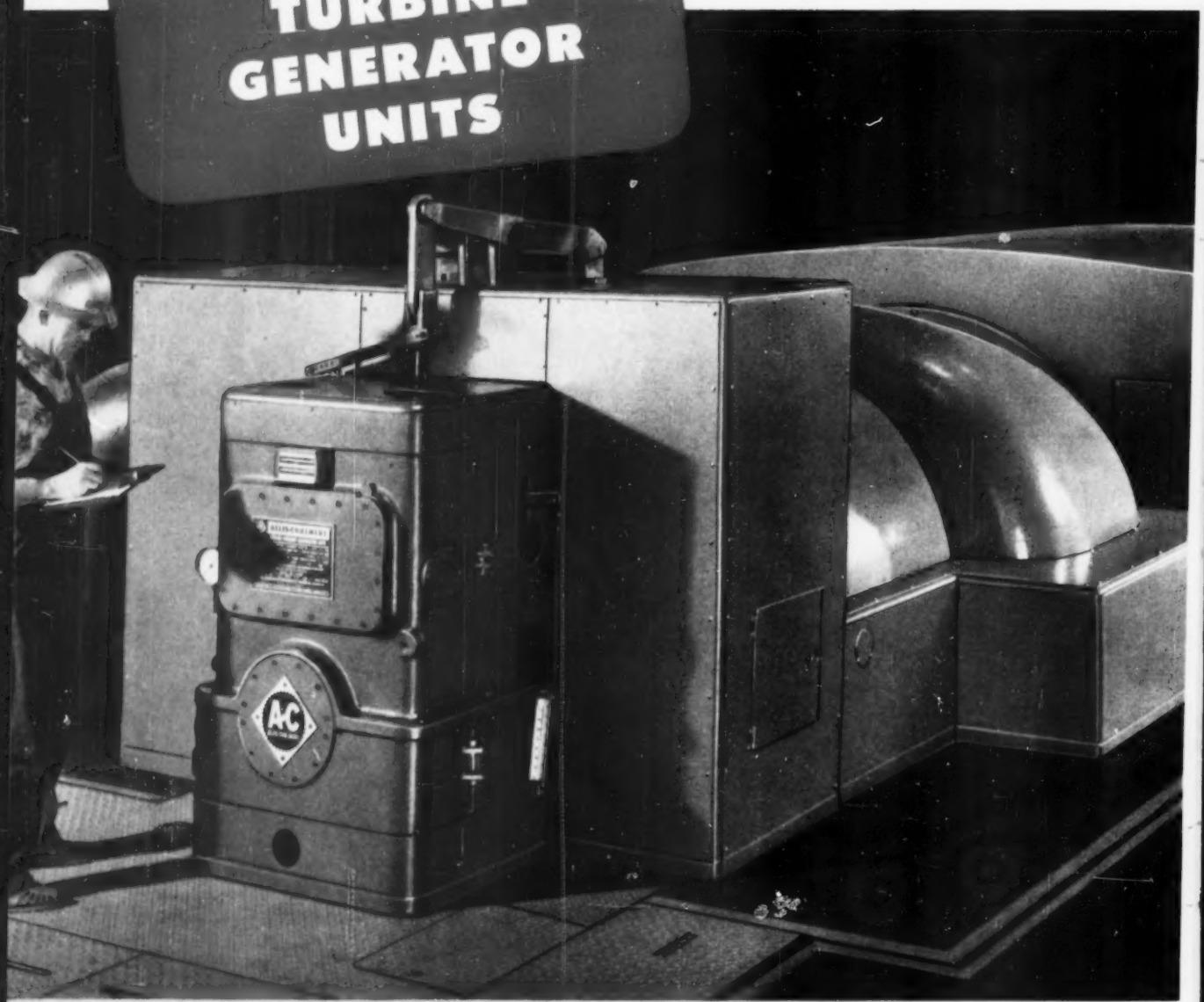
SPRINGFIELD BOILERS

Check with your Consulting Engineer on Modernization and New Plant Projects

For more data circle 521 on Post Card

Choice for

WA-Series STEAM TURBINE GENERATOR UNITS

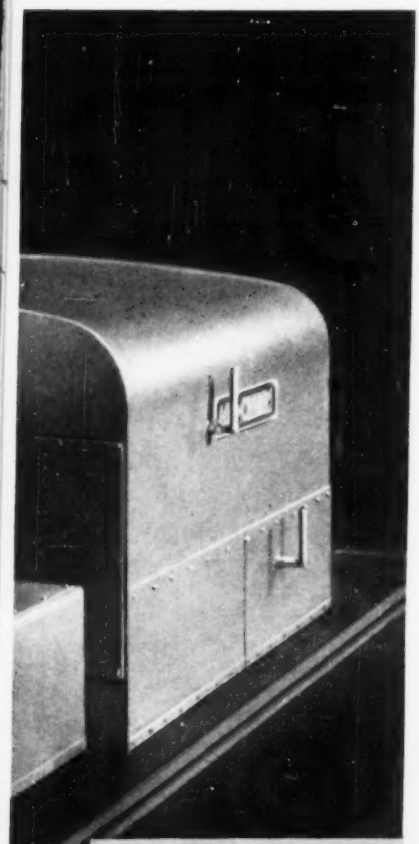


COMPLETE POWER PLANT at Tuscola includes three boilers and two WA-Series steam turbine generator units, shown above. Allis-Chalmers also supplied condensers and condensate pumps for the plant.

1904 50 1954
YEARS
Steam and Hydraulic
TURBINE
Manufacture

ALLIS-

New $44,000,000 Petro-chemical Plant



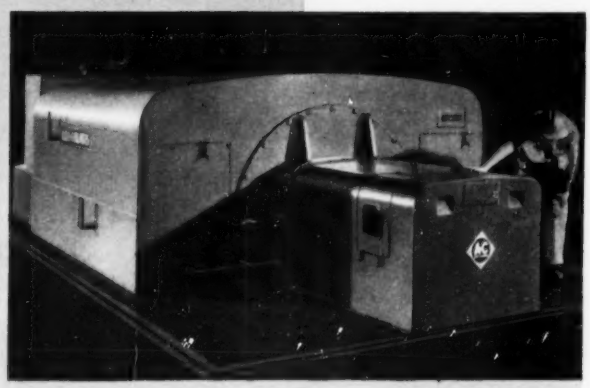
Two units generate power as by-product from steam required for processing natural gas

NATIONAL PETRO-CHEMICAL CORPORATION'S new Tuscola, Illinois, plant takes up to 425 million cubic feet of natural gas from the adjacent Panhandle Eastern pipeline, extracts 10 million cubic feet of ethane for cracking into valuable industrial chemicals, and returns the gas to the pipeline for transportation to big city customers.

To synthesize this huge amount of ethane into ethylene, hydrogen, and later into other useful components, fractionation and low temperature separation are used. The processes require 600,000 pounds per hour of steam, which is produced at 625 psig, 750 F.

Two condensing, automatic extraction WA-Series steam turbine generators are utilized to produce 10,000 kw of power from the steam before it is delivered into plant processes. The steam is delivered directly into the high temperature side of the automatic extraction impulse turbines, from which it is extracted at 65 psig for use in the plant. Each turbine generator unit is equipped with a housing-type, air-cooled generator and exciter. The entire units are carefully engineered and manufactured to operate as integrated units, 24 hours a day, 7 days a week.

WA-Series steam turbine generator units match the most modern plant design to provide high efficiency power or process steam. They are available in condensing or non-condensing types in NEMA ratings 2000 kw and larger. Bulletin 03B7654 gives complete facts. For your copy just call your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4477



OUTBOARD END of one unit shows exciter housing.

Simplified Installation and Maintenance

Every detail of WA-Series steam turbine generator units is designed for maximum simplicity and maintenance. Three-bearing construction, above-the-floor oil piping, and bracket-bearing, housing-type air-cooled generator are some of the features that result in a compact unit with simplified installation requirements. Turbine and generator are shipped with their rotors locked in place, further minimizing installation time.

Maximum reliability is assured by labyrinth spring-back steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and a time-proved governing system.

CHALMERS

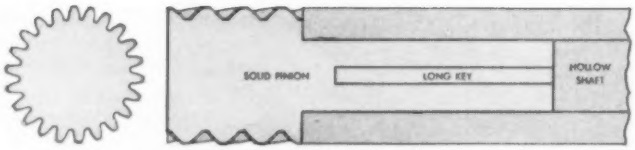
A-C ALLIS-CHALMERS

For more data circle 522 on Post Card

In your opinion, which pinion?

. . . for longest life in a gearmotor

ORDINARY SHELL TYPE PINION



U. S. SOLID TYPE PINION

In an internally geared motor the pinion on the motor shaft is the vital link between motor and gearing. It's the fastest, but smallest gear, so it must be extra strong, free from vibration and forever tight. Now compare the U. S. Syncrogear motor pinion with the ordinary type. Note the extra large section area of the U. S. design. It has a long solid shank that anchors into the motor's hollow shaft, whereas the ordinary shell type has a small section area, short keyed.

Obviously the U. S. design is most substantial, longer lasting, more resistant to deflection and can carry high speed loads far more safely than common designs. All the gears are deep-hardened and shaved to exact tolerances in the U. S. plants.

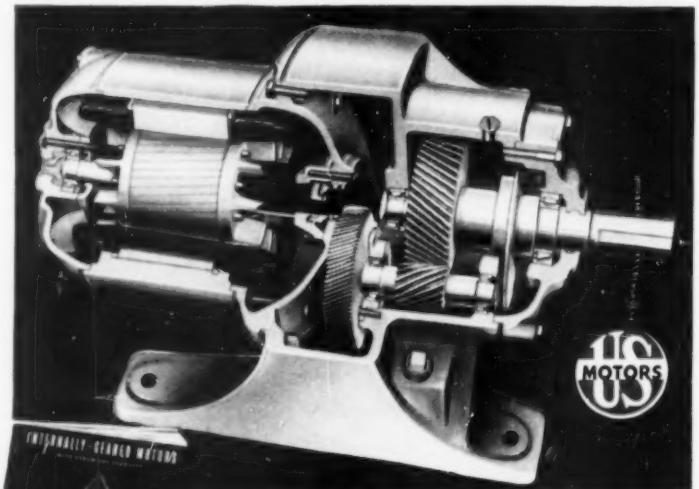
Added life lengthening features

The rugged pyramidal case supports the motor and gear train and all castings are normalized to insure permanent alignment and to prevent distortion. The motor windings are asbestos-protected to avoid carbonization and guard against burnouts. All moving parts are completely enclosed for weather and dust protection and confined within the least cubical dimensions on a single mounting. ¼ to 30 h.p.; 10 to 10,000 r.p.m.

THE ONLY MOTOR WITH A

BUILT-IN PINION

U. S. SYNCROGEAR



***FREE* 16-PAGE DESCRIPTIVE BOOKLET GIVES ALL THE FACTS**

Interesting multi-colored Booklet presents engineering facts you should know about geared motors, and illustrates the various U. S. Syncrogear types. Mail the Coupon for a copy. No obligation.

U. S. ELECTRICAL MOTORS Inc.

Los Angeles 54, Calif. **Milford, Conn.**

U. S. Electrical Motors Inc. PRE-12
Box 2058, Los Angeles 54, Calif. or Milford, Conn.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

For more data circle 523 on Post Card

Here's Help in Understanding STEAM-WATER CYCLE ANALYSES

OFTEN, constituents of deposits in steam-water cycles are reported to you in mineral names rather than chemical formulas. To help you better understand reports and analyses with these names, Allis-Chalmers has published a new Informational Bulletin, Number 59. It lists each mineral, then gives the chemical formula, the usual area in which these deposits are found, and the causes and possible preventive measures you can take.

Part of Practical Library

Only careful analysis of all the factors in the cycle can solve a specific water problem. This bulletin will help you understand, generally, the causes and solutions of a variety of water problems. It is one of a series published by Allis-Chalmers. These bulletins reflect Allis-Chalmers wide experience from years of solving water problems in every industry, in addition to solving problems involved in the company's own broad line of power plant equipment.

ALLIS-CHALMERS WATER CONDITIONING
Equipment — Chemicals — Service

Complete Water Conditioning Service

Allis-Chalmers offers complete water conditioning service. You can get analyses and reports on your problems. You can get chemicals needed for water treatment. And you can get the equipment needed for any system.

For your copy of Informational Bulletin 59 explaining the mineral names used in analyses, write Allis-Chalmers, Milwaukee 1, Wisconsin. Or better, call your nearby A-C office to have an Allis-Chalmers water conditioning engineer consult with you on your problem. A-4414

Complete investigative facilities at Allis-Chalmers research laboratories include this X-ray diffraction unit which is used to analyze crystalline structure of deposits from steam-water cycles.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

For more data circle 524 on Post Card

FUEL SAVING

HAGAN

automatic control systems

HAGAN

ring balance instruments

is our business

The primary purposes of every installation of Hagan Automatic Combustion Control and Instrumentation are to save fuel, and to provide the indications and records which guide the operators in maintaining maximum efficiency.

Each component of a Hagan System is selected to perform a specific function accurately and dependably, and to coordinate smoothly with all other related components in the system.

Back of every system, irrespective of size, there are more than thirty-five years of experience in development, design and application of Automatic Combustion Control and Instrumentation. As a result, Hagan Systems are easy to install, easy to calibrate and easy to keep in topnotch operation.

These typical applications emphasize the versatility of Hagan equipment and Hagan methods:

- Automatic combustion control systems for boilers of any size and pressure, burning all types of fuels, singly or in multiple.
- Boiler drum water level control, with automatic correction available for such factors as boiler load and boiler water density.
- Automatic control of gas and air temperatures for air preheaters.
- Draft and pressure controls for a continuous range from high vacuum to 5000 psig.
- Superheated steam temperature control.
- Pressure and temperature controls for feedwater heaters.
- Recording, indicating and totalizing flows of liquids, vapors and gases. Interchangeable sensing elements are available for full scale differentials from 1" to 560" WC.
- Simultaneous records of two separate flows, measured in a single meter housing. Flows may be added or subtracted.
- Pressure and temperature compensated records of steam and gas flows.
- Density compensated records of liquid flow or level, or for gas flows.
- Pneumatic and electric signal transmitters.
- Flow ratio control for liquids and gases.

Our engineers will be glad to suggest the Automatic Control and Instrumentation to fit your requirements.

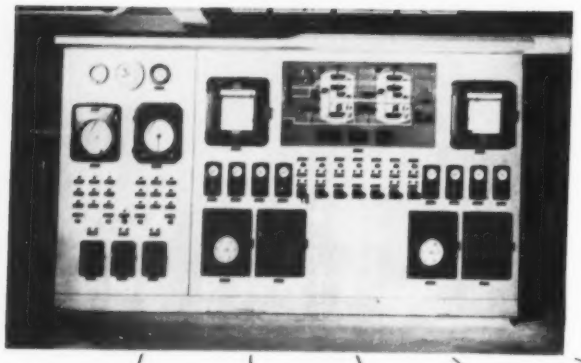
Hagan Corporation

HAGAN HALL BUROMIN CALGON

HAGAN BUILDING PITTSBURGH 30, PENNSYLVANIA

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems Control Systems for Automotive and Aeronautical Testing Facilities

For more data circle 525 on Post Card



10,000,000 ohm-cm.

10,000,000 ohm-cm.

10,000,000 ohm-cm.

10,000,000 ohm-cm.

10,000,000 ohm-cm.

10,000,000 ohm-cm.

10,000,000 ohm-cm.

NOW...10,000,000 ohm-cm. water!

at 160 gpm for 2050 psig boilers... by Demineralization

Just a few years ago, producing large quantities of water of a purity of 0.01 ppm was quite a chore. A tedious, drawn out multiple distillation technique was required. Engineers "dreamed" of producing this water at large flow rates for high pressure boilers and power plants by an easier and more economical method.

Today, at the Pennsylvania Electric Company, Shawville Station, this has become a reality. Makeup for 2050 psig boilers is produced at a rate of up to 160 gpm and with a purity of 10,000,000 Ohm-cm (0.01 ppm) and **less than 0.02 ppm silica** by a fully automatic Graver Mixed-Bed Demineralizer with in-built dependability.

Write for new Demineralizing Bulletin.

GRAVER

GRAVER WATER CONDITIONING CO.

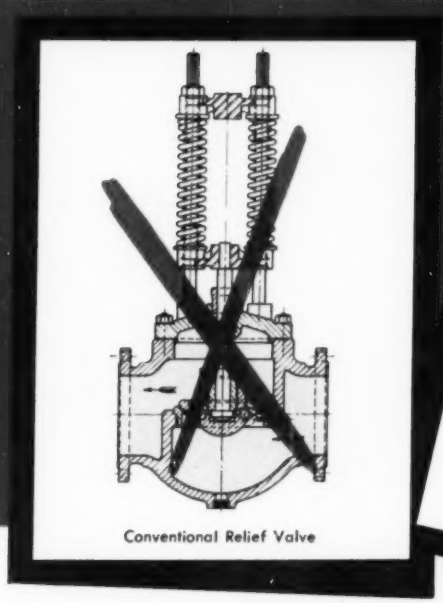
A Division of Graver Tank & Mfg. Co., Inc.

216 West 14th Street, New York 11, N.Y.

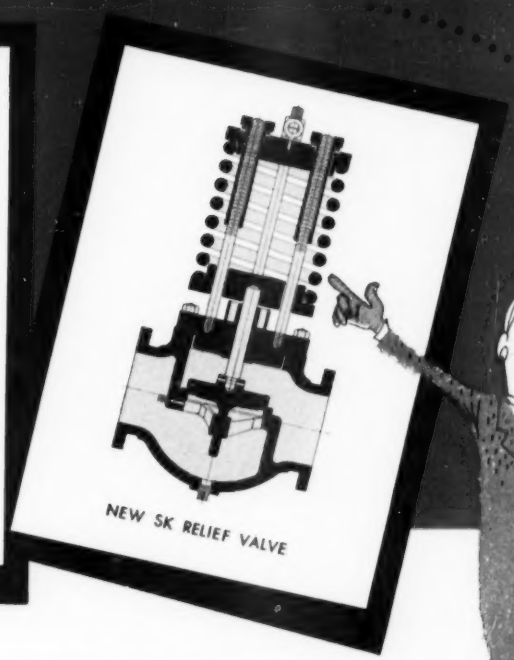
For more data circle 526 on Post Card

NOTICE ANYTHING UNUSUAL ABOUT THIS RELIEF VALVE?

ITS NEW FEATURES ARE TYPICAL EXAMPLES OF SK ADVANCED DESIGN



Conventional Relief Valve



NEW SK RELIEF VALVE

Look again . . . at the diagram of the conventional relief valve and the new SK Relief Valve beside it. Note the uncommon features of the SK Valve . . .

. . . Single Spring Construction. This eliminates the cumbersome, unstable superstructure of conventional, multiple-spring relief valves.

. . . Large Coil Diameter and Heavy Spring Wire Cross Section. This provides maximum spring stability; there is the least possible difference between pressure needed to unseat the valve and that required to force it full open.

. . . Valve-Spindle Guides Both Above and Below Valve Disc. These assure accurate seating and permit the use of valve in any position and its installation in vertical or horizontal pipelines.

. . . Reduced Over-all Height Through the Use of Reach Nuts. This eliminates long spring rods and permits the use of rods which do not extend beyond the upper spring plate after compression.

BUT THIS IS NOT ALL!

Right now—while you read this—new products and improvements are taking form on our drafting boards, and others are being third-degree'd in our research and testing laboratories. We call this "Progressive Design"—a job at which we excel because we have the staff, the background, the ability and the facilities to deal with the toughest problems. We invite you to prove this. If a design puzzle has you frustrated, bring it to us. No obligation, of course.

SEND FOR YOUR FREE COPY OF NEW VALVE BULLETIN V-1

It describes, in condensed form, the line of valves made by SK. You'll find it a gold mine of information.

Schutte and Koerting
COMPANY
MANUFACTURING ENGINEERS

2221 STATE ROAD, CORNWELLS HEIGHTS, BUCKS COUNTY, PA.

Jet Apparatus • Heat Transfer Equipment
Strainers • Condensers and Vacuum Pumps
Oil Burning Equipment • Rotameters
Flow Indicators • Radiation Tubes • Valves
Spray Nozzles and Atomizers • Gear Pumps
Desuperheaters

For more data circle 527 on Post Card

"Dated" instruments drain away dollars

Instruments can become outmoded . . . just like automobiles and ideas. Progressive instrument development is constantly making many older designs obsolete . . . and such obsolescence can be a steady drain on profits.

Modern instruments save money

Honeywell engineers are proving this fact every day—in a growing number of plants, on all types of processes. Where out-of-date controls have been replaced by modern Honeywell instrumentation, economy-minded engineers and management men have really opened their eyes. And with good reason, for—

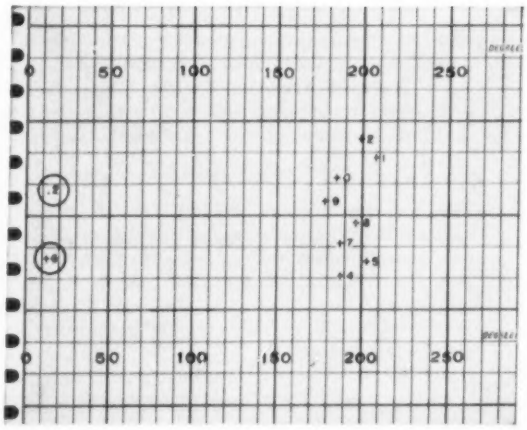
- Modern Honeywell instrumentation saves labor. Centralized control, automatic time-cycle systems, and other recent control concepts save countless wasted steps . . . reduce routine man-hour expenditures.
- Modern Honeywell instrumentation cuts maintenance costs. It affords longer, uninterrupted operation . . . is designed for easy service . . . requires minimum attention.
- Modern Honeywell instrumentation reduces rejects. It maintains the tighter process tolerances demanded by today's more exacting specifications.
- Modern Honeywell instrumentation improves product quality. Precision measurement and control remove any chance of error or guesswork in critical processes.
- Modern Honeywell instrumentation makes cost accounting more accurate than ever before. Everything is a matter of record.

An investment that really pays off

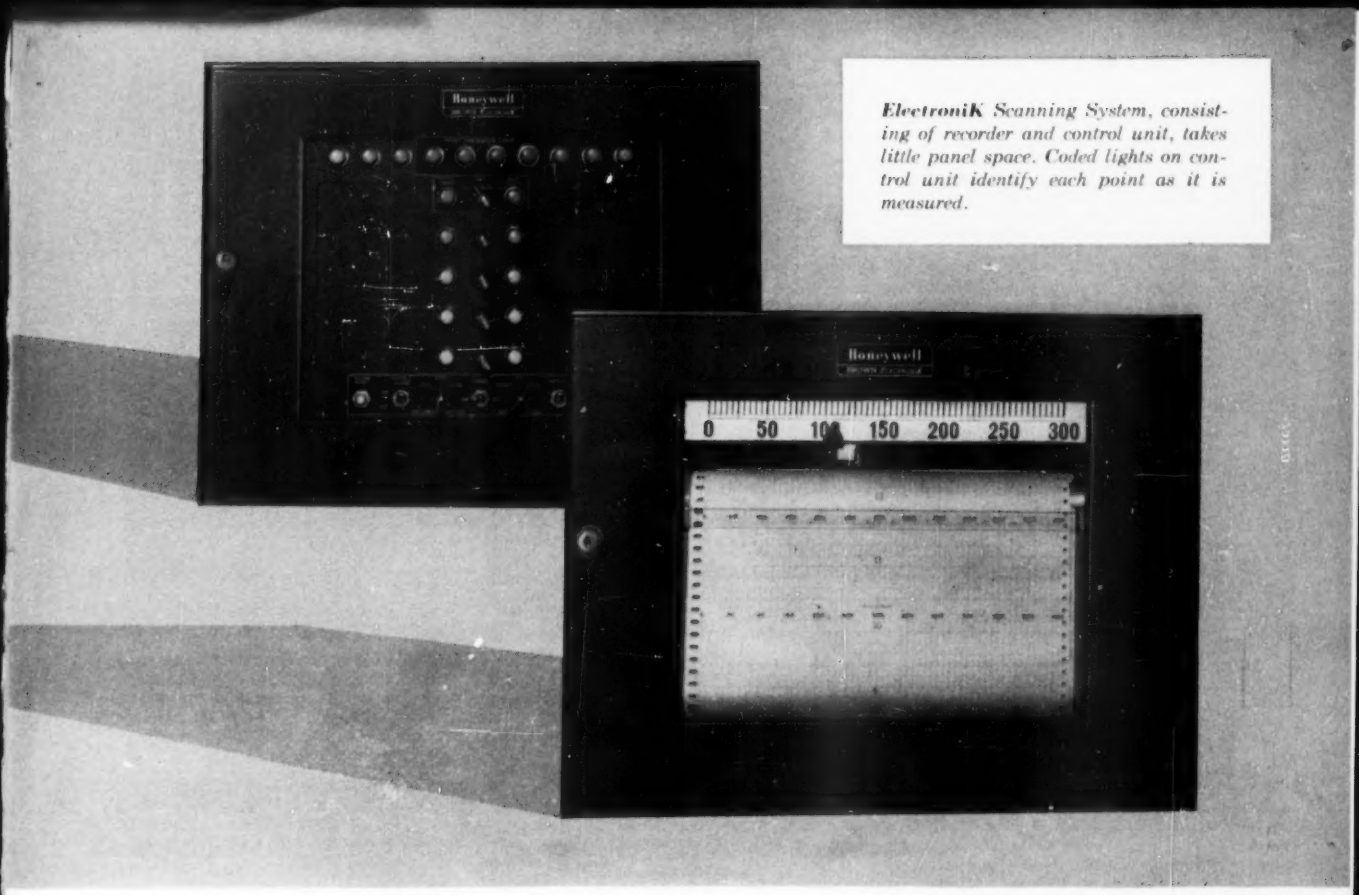
Just being "instrumented" is not enough. You can get more out of your instrument dollar, from both a product and service standpoint, with Honeywell instrumentation . . . the ultimate in engineering and design . . . insurance for your equipment investment.

Replacing with Honeywell is one of the best ways to invest your modernization appropriation. A Honeywell application engineer will gladly survey your present plant instrumentation . . . give you a practical recommendation that will make dollars and sense. Give him a call . . . he's as near as your phone.

This economical, versatile system monitors up to



Sample chart shows how all 270 points are clearly identified on the record.



ElectroniK Scanning System, consisting of recorder and control unit, takes little panel space. Coded lights on control unit identify each point as it is measured.

270 plant temperatures

THE TIME, expense and uncertainties of periodic tours to check temperatures at potential "hot spots" in the plant can be materially reduced by the *ElectroniK* Scanning System. This instrumentation makes temperature monitoring completely automatic and efficiently centralized. A single instrument watches 270 different temperatures in bearings, oil lines, boiler tubes, pumps . . . anywhere you can install a thermocouple.

Because of its exceptionally large capacity, the *ElectroniK* Scanner does the work of up to 16 old-style instruments . . . affords effective overheat protection at low cost per point.

It's fast—scans through successive thermocouples at speeds up to one second per point. Each point is checked at 4½ minute intervals . . . far more frequent than the best manual checks.

It signals overheat. Annunciator contacts are actuated whenever any point in a bank of nine exceeds a preset limit. Different limits can be set for each bank.

It's versatile. At the flick of a switch, the operator can choose:

1. Continuous recording of all 270 points, with positive identification of each.
2. Recording of only those points which exceed a preset limit.
3. Continuous scanning without recording.
4. Selective recording or scanning of pairs of nine-point banks.

Models with less than 270 points are available to meet your individual needs. Your nearby Honeywell sales engineer will be glad to discuss your own plant's requirements . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for Data Sheet No. 10.0-9, "*ElectroniK* Scanning System."

MINNEAPOLIS **Honeywell**
BROWN INSTRUMENTS
First in Controls

For more data circle 528 on Post Card

CONSTRUCTION NEWS

El Segundo, Calif. — Southern California Edison Co., 601 Fifth St., has work in progress on new steam-electric generating station, to be known as Tidewater Plant, and proposes to have station ready for operation next July. As previously noted in these columns, plant will have an initial capacity of 156,000-kw. On completion of first unit, work will proceed on expansion to double that capacity, expected to be completed in fall of 1956. Entire plant is estimated to cost about $46,000,000.

Canon City, Colo. — Southern Colorado Power Co., Pueblo, has begun construction of proposed new steam-electric generating plant at Canon City, as previously reported in these columns. Building will be about 90 by 100 ft. and 80 ft. high. Installation will include a turbine-generator unit of 16,500-kw. rating, high-pressure boiler and auxiliary equipment. Project is scheduled for completion in 1955 and is estimated to cost about $3,500,000.

Miami, Fla. — Florida Power & Light Co., 25 South 2nd St., has arranged a construction budget of about $80,400,000 for 1954–55, including generating plants, transmission lines, power substations and other expansion.

Tampa, Fla. — Tampa Electric Co. has arranged financing through sale of preferred stock, totaling about $5,000,000, proceeds to be used in connection with current construction program, including power stations, transmission lines, power substations and other facilities.

Grand Tower, Ill. — Central Illinois Public Service Co., Springfield, Ill., has authorized expansion in steam-electric generating station at Grand Tower, with installation of new 100,000-kw. turbine-generator unit, high-pressure boiler and auxiliary equipment. Proposed to begin work in near future, with completion scheduled early in 1957.

Woodstock, Ill. — Municipal Lighting Dept. has plans under way for extensions in municipal power plant, with installation of equipment for increased capacity. Cost reported over $500,000.

Ford, Ky. — Eastern Kentucky Rural Electric Cooperative Corporation, Winchester, Ky., has plans maturing for expansion in William C. Dale power plant, near Ford, with installation of new 66,000-kw. generating unit, high-pressure boiler and auxiliary equipment. Program will include extensions in transmission lines, power substations and other operating facilities, and is reported to cost in excess of $6,000,000.

Alexandria, La. — Central Louisiana Electric Co. has arranged financing to provide a fund of about $1,000,000 for extensions and improvements in power plants and system, to be carried out in conjunction with 1954 construction program.

Franklin, La. — Municipal Power Plant Dept. has approved plans for extensions and improvements in Diesel-electric municipal power station, with installation of new dual fuel engine-generator and auxiliary equipment.

Boston, Mass. — New England Electric System, 441 Stuart St., has arranged financing in amount of $13,500,000, proceeds to be used for expansion and improvements in power plants and system, including increase in generating facilities, transmission lines, power substations and other work.

Detroit, Mich. — Chrysler Corp., 12200 Jefferson Ave., has plans under way for addition to steam power house at local automotive plant, with installation of equipment for increased capacity. Work will be carried out in connection with other plant additions. No estimate of cost announced. Albert Kahn Associated Architects & Engineers, Inc., New Center Bldg., Detroit.

Minneapolis, Minn. — Northern States Power Co., 15 South Fifth St., has disposed of a bond issue of $20,000,000, proceeds to be used in connection with expansion and improvement program, now in progress, for a 24-mo. period, 1954–55, recently noted in these columns. A considerable part of fund will be used for increased generating facilities. Entire program for period noted will represent an investment of about $100,000,000.

St. Louis Park, Minn. — Bd. of Trustees, Asbury Hospital, 916 East 15th St., Minneapolis, Minn., plans boiler plant at proposed new multi-unit hospital on Excelsior Blvd., St. Louis Park. Entire project is reported to cost about $3,500,000. McEnary & Krafft, McKnight Bldg., Minneapolis, are architects.

Springfield, Mo. — City Council has secured approval of a bond issue by vote of citizens for $11,127,000 for construction and operation of a municipal power plant.

Asbury Park, N. J. — Jersey Central Power & Light Co., 501 Grand Ave., has sold a note issue of $3,000,000, fund to be used in connection with current construction program, including power plants, transmission lines, distribution system.

Poughkeepsie, N. Y. — Central Hudson Gas & Electric Corp. has disposed of a bond issue and block of preferred stock, to provide a fund of about $13,000,000, to be used in connection with 1954–55 construction and improvement program, covering increased generating facilities, transmission lines, power substations and miscellaneous work.

Belmont, N. C. — Duke Power Co., Charlotte, N. C., has authorized plans for new steam-electric generating plant near Belmont, where site has been selected on Catawba River, to be known as Allen generating plant. It will have an initial rating of 165,000-kw., and is scheduled to be ready for service in June 1957. Plant will be designed for an ultimate rating of 1,000,000-kw., and work on second unit will proceed on completion of first. Project will include extensions in transmission lines, power substations and other operating facilities.

Dayton, Ohio — Dayton Power & Light Co., 25 North Main St., has disposed of a bond issue of $15,000,000, proceeds to be used in part for expansion and improvements in generating facilities, power substations, transmission lines.

Miamisburg, Ohio — Municipal Light & Water Dept. plans extensions and improvements in municipal steam-electric generating station, with installation of additional equipment for increased capacity. Fund of about $900,000 is being arranged for program, including extensions in electrical distribution system.

Norwalk, Ohio — Municipal Electric Dept. has preliminary plans under way for expansion in city-owned steam-electric generating station, with installation of new 7500-kw. turbine-generator unit, boiler and auxiliary equipment. Cost reported in excess of $1,000,000.

Tulsa, Okla. — Public Service Co. of Oklahoma, 600 South Main St., has authorized an expansion and modernization program in local steam-electric generating station, to be carried out over a period of months. Work will include installation of three new turbine-generators, with high pressure boilers and auxiliary equipment, designed to double present plant rating. Completion is scheduled early in 1958. Entire project will represent a reported investment of $40,000,000, including extensions in transmission lines, power substations, distribution lines and other facilities.

Medford, Ore. — California-Oregon Power Co. has secured fund of $1,150,000 through note issue, proceeds to be used in connection with current expansion and improvement program in power plants and system.

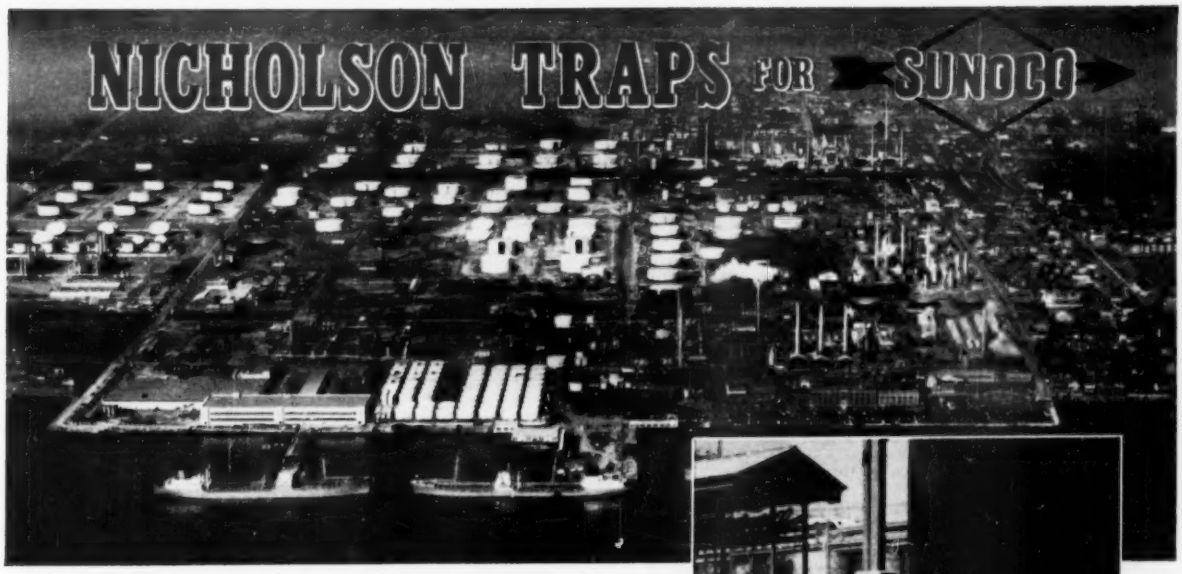
Portland, Ore. — Portland General Electric Co., 621 S.W. Alder St., is arranging financing through bond issue to provide a fund of about $4,000,000, to be used for expansion and improvements in power plants and system.

Beech Island, S. C. — South Carolina Electric & Gas Co., 328 Main St., Columbia, S. C., has plans under way for new steam-electric generating station on Savannah River, Beech Island. It will be equipped for large capacity. Details of installation will be determined soon, including turbine-generator, high-pressure boiler, switchyard and auxiliary facilities. Entire program will represent a reported investment of about $25,000,000, including power substations, transmission lines and other distribution facilities.

Denton, Tex. — At recent special election, Water & Light Dept. was authorized by a vote of citizens to arrange for a bond issue of $2,750,000 for extensions and modernization in municipal power plant, previously referred to in these columns. Program will include installation of additional equipment for increased capacity, and improvements and remodeling of certain existing facilities. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

Seattle, Wash. — City Department of Lighting, 1015 Third Ave., has plans for installation of new turbine-generator and auxiliary equipment in Ross power plant, reported to cost close to $2,000,000, with switching station, transmission lines, etc.

Winnebago, Wis. — State Dept. of Public Welfare, State Capitol, Madison, Wis., plans boiler house in connection with new laundry and food service building at institutional building at Winnebago. Entire project reported to cost about $1,400,000. Roger C. Kirchoff, State Capitol, Madison, is state architect.



Air view of Sun Oil Company's refinery at Marcus Hook, Penna.

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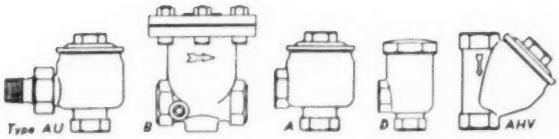

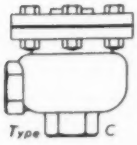

SIX TYPES FOR PROCESS, HEAT AND POWER -- Construction of bronze, semisteel or cast steel. In sizes of ¼" to 2" for pressures to 300 lbs. All six types of traps have stainless steel valves and seats. Bellows are furnished in bronze, monel or stainless steel.

Send for TRAP CATALOG

Nicholson steam traps are shown above installed on storage tanks requiring heating at Sun Oil Company's Marcus Hook, Pa., refinery. Sun has standardized on this type of installation.

W. H. NICHOLSON & CO.

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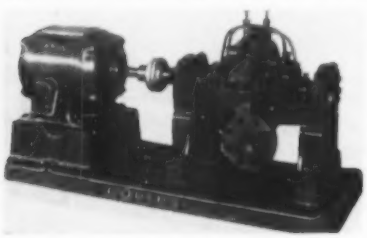
EQUIPMENT NEWS

1—DIRECT BURIAL CABLE designed to combat corrosion

Offered as an aid in the battle against corrosion of buried metallic structure, is the Type CP Cable. When used in cathodic protection equipment, this direct burial cable is reported effective in refineries, steel substructure in chemical plants, and around power plants and substations and similar installations. CP Cables are available in sizes 8 through 4/0, single conductor, 600 v. They can be of either a rubber-Neoprene construction (company's Durasheath), or all plastic, with polyethylene insulation and red PVC jacket. Anaconda Wire & Cable Co.

2—TWO-STAGE PUMPS for handling clear liquids

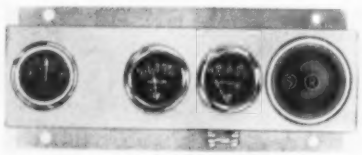
Pumps in the new Fig. 3305 line come in five sizes providing heads to 1000 ft and capacities to 1000 gpm. Designed for operating efficiency and ease of maintenance these pumps have horizontally split casing and are so constructed that the interior can be inspected and rotating parts removed and



replaced without disturbing piping connections. Opposed impellers assure hydraulic balance, says manufacturer, and thrust balance is achieved by the use of a new labyrinth diaphragm. Bearing spans have been kept short.

Wide interchangeability of parts is provided in this line of pumps and many of the parts are also interchangeable with those of company's Fig. 3405 line of single-stage pumps. Direction of rotation of the new pumps can be changed in the field, without additional parts, by means of a locking shaft sleeve. The pumps can be supplied with either conventional stuffing boxes or mechanical seals. Goulds Pumps, Inc.

Described on these pages are new and improved products. Use Reader Service Cards on pages 113–114 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.



3—SAFETY PANEL for the remote controlled engines

This panel serves to protect unattended or remote-controlled engines such as on air compressors, sump pumps and generator sets, from burned bearings, frozen pistons or other failures. Designed for engines with battery ignition, the panel consists of an oil pressure gage and water temperature gage in combination with an engine shut-off switch; an ammeter; stop switch and re-set and 14-amp fuse. Panels for magneto ignited and diesel engines are available.

It is explained that the panel automatically shuts off should oil pressure of the engine drop too low due to an inoperative pump, lack of oil, clogged or broken oil line; or should engine temperature rise too high because of an inoperative water pump, clogged radiator, leaks in the cooling system or because of a broken fan belt. Minimum oil pressure or maximum engine temperature at which it is desired to shut off the engine is pre-determined by the position of "stop" on the face of the gage. Stop positions are adjusted by turning a regulating screw on the back of each instrument. The panel case is heavy gage steel, 12 in. long. All instruments, wiring are under cover. Instrument Div., Stewart-Warner Corp.

4—ACID-RESISTING PACKING has high tensile strength

R/M 1307 is announced as an acid-resisting compressed asbestos sheet packing made of selected white asbestos fibres impregnated and coated with an acid-resisting compound. Manufacturer says that gaskets cut from R/M 1307 will not be as fragile or brittle as those made from blue asbestos fibres, because it has higher tensile strength and better flexibility. Processing is said to be relatively easy. Company recommends R/M 1307 for use against sulphuric, nitric and other acids in various concentrations where a tight seal in flanges is necessary, and for temperatures as high as 400 F. Packing Div., Raybestos-Manhattan, Inc.

5—MOTORIZED GAS VALVES for automatic fuel control

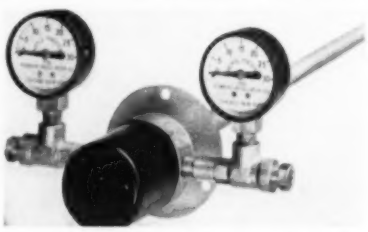
Two-wire motor operator, soft Neoprene seat construction and sturdy lightweight aluminum body are features announced for this line of motorized gas valves for automatic fuel control on gas-fired boilers, furnaces and other gas combustion systems. The spring-loaded plunger and Neoprene seat are designed to provide fast, positive shut-off in the event of electrical failure. Motor and plunger assembly are easily removed for servicing, the valve without breaking line connections, it is pointed out. Position of the diaphragm (open or closed) is shown by an indicator on the motor mounting bracket. Flange mountings with aluminum companion flanges are standard equipment. The valves are produced in six sizes from 1 to 4 in. Eclipse Fuel Engineering Co.

6—STRAINER, cylindrical type with wire mesh basket

Although designed for heavy oils and other viscous liquids, this strainer can be used with any liquid that does not affect steel or stainless steel, says manufacturer. It is available in nine sizes with capacities from 6 to 7050 gpm when handling oil of 100 SSU viscosity — the capacity of any size strainer varying according to viscosity of liquid being handled. The flow of liquid may be in either direction through the strainer, but manufacturer recommends from outside in on the smallest strainer and from inside out on the larger models. It is noted that, to a marked degree, the strainer is self-cleaning because the heavy particles of foreign matter removed from the liquid settle to the bottom of the cylinder, allowing the vertical sides of the wire mesh basket to remain free for continued work. Wm. W. Nugent and Co., Inc.

7—TEMPERATURE CONTROL is low cost pneumatic unit

An inexpensive non-bleed pneumatic temperature control is announced for operation of diaphragm valves, damper motors, and other types of control equipment. Known as the Limitem, it is a differential expansion type control



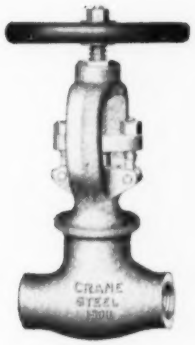
designed for precision regulation of heating, cooling, ventilating, air conditioning, dew point control and industrial processes. Temperature range of the control is from 35 to 135 F. Manufacturer says the graduated dial permits quick, easy adjustment — sensitivity can be adjusted from ½ to 2 psi per 1 deg temperature change — gradual acting. Body is 1¾ in. OD and average bulb length 18 in. with ¾ in. pipe or flange connection. It is available with direct action only. More information is furnished in Bulletin 308. The Powers Regulator Co.

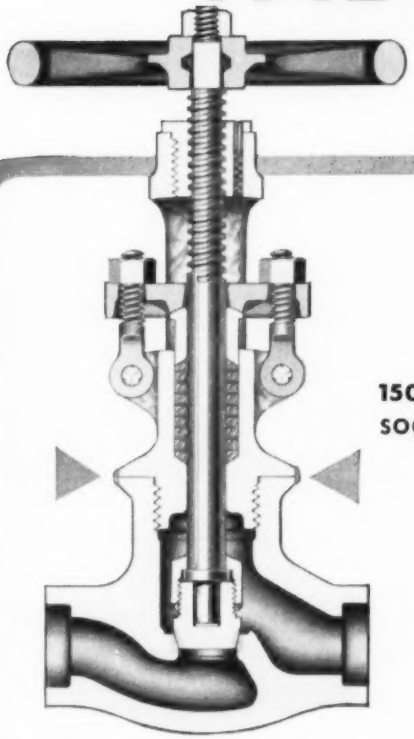
8—RUST CONVERTER forms protective coating on steel

A rusted surface treated with FerRoSeal is a better base for paint or coatings than clean steel, according to manufacturer of this liquid which is formulated to con-

newest in small steel valves for high-pressure/high-temperature

CRANE
lip-seal bonnet (patented)
VALVES





Lip Seal design is exceedingly simple. Body and bonnet are screwed together until a firm metal-to-metal contact is made between the smoothly machined flat surface on the shoulder of the bonnet and the top of the body. The small lips around the periphery are then seal welded.

- **Absolute Bonnet-Joint Tightness**
- **Freedom from Bonnet-Joint Maintenance**
- **Minimum Weight and Bulk**
- **Easier Dismantling and Reassembly**

1500 AND 2500-POUND GLOBE AND ANGLE PATTERNS
SOCKET-WELDING AND SCREWED ENDS. SIZES ½ TO 2-INCH

What better way to seal against leakage at the bonnet joint of a small steel valve . . . than with a simple weld. And that's all the weld is ever called upon to do. Extra-long body-bonnet threads carry all mechanical loads—and at comparatively low stresses. Should dismantling be necessary, the seal weld may be repeatedly ground off—and reapplied—without damage to valve.

Right along with this modern Crane sealing principle go other important refinements. You get a compact, weight-saving structure without sacrificing strength or reducing seat area—a more rigid swivel disc-stem connection—durable Stellite-faced plug-type disc—and Stellite-faced integral seat.

Crane Lip-Seal Bonnet Valves are by far your best buy for high-pressure/high-temperature power services . . . worthy companions to the larger Crane Pressure-Seal Valves. Ask your Crane Representative for Circular AD1902, or write direct.

THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

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vert rust chemically into a protective iron phosphate coating. The process is intended to eliminate need for usual rust removal procedures.

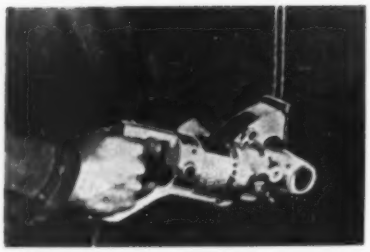
Extension of paint life three to five times by FerRoSeal action as a seal and bond against further rust and corrosion is claimed on the basis of laboratory tests covering weathering, exposure to industrial atmospheres, salt spray and humidity. Distributor says FerRoSeal is not an additive, and that it works in harmony with coal tar products, asphaltum, gilsonite, vinyls, silicons, Neoprene, zinc base materials, paint. A gallon covers a metal surface of about 1000 to 1500 sq ft, depending on thickness of rust layer. Chemical Div., Municipal Steel Corp.

9—BUSHING, for electrical connections, permits easier use

A ½-in. bushing for electrical connections has been improved to allow easier installation. Designed with a flared skirt for easier starting and deep-cut threads to permit maximum tightening with the fingers, this bushing has prominent raised lugs for final setting with a screwdriver. A smooth curled throat protects wire insulation from cutting. National Electric Products Corp.

10—BLOWOFF SYSTEM affords heat and fuel economy

This continuous blowoff system not only maintains uniform dissolved solids concentration in the boilers, manufacturer says, but in most cases provides heat savings sufficient to amortize the initial investment. It is pointed out that practically all heat contained in the blowoff is returned to the feed water system and, at the same time, uniform boiler concentrations facilitate smooth steaming, reduce overload tendencies on the feed water equipment resulting from intermittent blowdown methods, reduce wear on main boiler blowdown valves and provide for more efficient operation of the boiler plant. Utilizing the flash principle, steam from the concentrated boiler is used in the feed water heating system, while unflashed boiler water passes through a heat exchanger located in the makeup water line. Complete details are given in Publication 5700. Cochrane Corp.



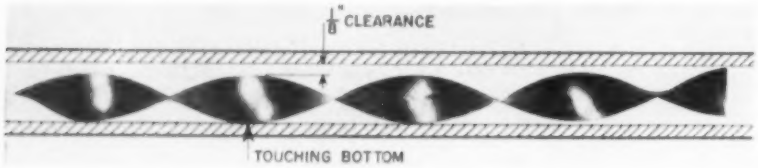
12—PLASTER CUTTER is portable electric tool

Developed to save time, labor and materials, this tool is 16½ in. long and weighs only 13 lb. It consists of a case which houses a motor operating on an a-c or d-c current; two abrasive wheels with guard, equipped with support handle; and a handle designed for easy grip to which is attached a trigger switch and 15 ft of Neoprene cord with plug-in for any outlet.

According to company, the cutter does a neat, clean job and prevents cracking of the plaster. It makes two parallel cuts in the plaster by running the unit along the surface, after which the plaster between the cuts is taken out with a chisel. Although intended for use in the installation of metal conduit in plastered walls and ceilings, the cutter may be used for making single cuts for repairing cracks, and for scoring tile and other hard materials. Depth of cut is regulated by adjustment of wheel guard. The wheels may be set to cut grooves of different widths up to 1¼ in. Wodack Electric Tool Corp.

13—DIAPHRAGM VALVES with polyvinyl chloride bodies

In response to the growing interest in polyvinyl chloride, this company has added valves with bodies of PVC to their line of Saunders Patent Diaphragm Valves. Coupled with the design of these valves, PVC expands the extensive list of corrosive materials that can be handled, it is noted, and also provides a corrosion resistant valve for PVC piping layouts. Handwheel-, lever-, sliding stem-, and air-operated types are available in sizes ranging from ½ through 2 in. Hills-McCanna Co.



11—TURBULATORS to step up efficiency of boiler fire tubes

Airnesco Turbulators are strips of metal, tailored to boiler dimensions and jointed every 3 ft for convenient handling. There is no need for alterations to fit these turbulators, it is pointed out; and they are easily handled and have a long life. Tubes fitted with them are reported to stay clean longer than when fitted with many types of turbulators. According to company, the increase in heat transfer and improvement in efficiency is accompanied by only a slight increase in draft loss.

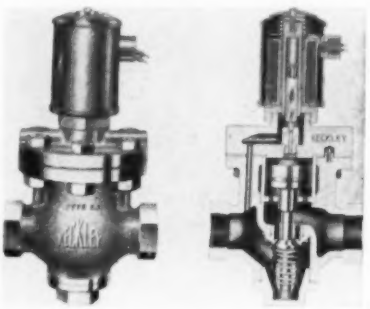
Although intended primarily for use in the horizontal return tubular boilers, they may be used in any type of heat exchanger. As explained, their action is twofold: in a straight tube, the speed of flow of a fluid or gas is greatest at the center of the tube. The turbulators, being the full diameter of the boiler tubes, cause the fluid to rotate and break up the uneven flow. Also, the mass of metal absorbs heat from the fluids and, in turn, radiates this heat outwardly. C. F. Carpenter.

14—TACHOMETER GENERATOR has high voltage output

A low-cost d-c tachometer generator, announced for a variety of control applications and speed indications, can provide a high voltage output of 50v/1000 rpm for speeds to 5000 rpm, and 100 v/1000 rpm for speeds to 2500 rpm. According to company engineers, it is an ideal pilot exciter for many control applications. Industrial applications include measuring and controlling speed in manufacture of steel, aluminum, and paper, and on machinery. It is totally enclosed, can be either flange or foot mounted, and may be mounted vertically or horizontally. It is equipped with conduit box with a ½ in. straight pipe thread which permits conduit if desired. Shaft extension has flat section and stub shaft at one end for hand tachometer measurements. General Electric Co.

15—SOLENOID VALVES are pilot-operated units

Type EA, announced as a line of pilot-operated solenoid valves, is designed for steam service at pressures to 250 lb or air, water, oil and gas service to 600 lb. Sizes are ½ through 6 in. Valve bodies are bronze or semi-steel; pilot



valve, main valve and seat are stainless steel. Teflon seat rings for both pilot and main valve seat are available for positive shut-off on air, gas and water service. Solenoid coils are glass insulated heavy duty, moisture-proof type for high temperature and pressure service. The main valve body and parts are identical to, and interchangeable with, those of company's standard pressure and temperature regulators, providing an economic advantage to users. In operation, the main valve opens when the solenoid pilot valve opens, admitting pressure to the top of the main valve piston. When the pilot valve closes, pressure above the piston relieves, allowing the main valve to close. O. C. Keckley Co.

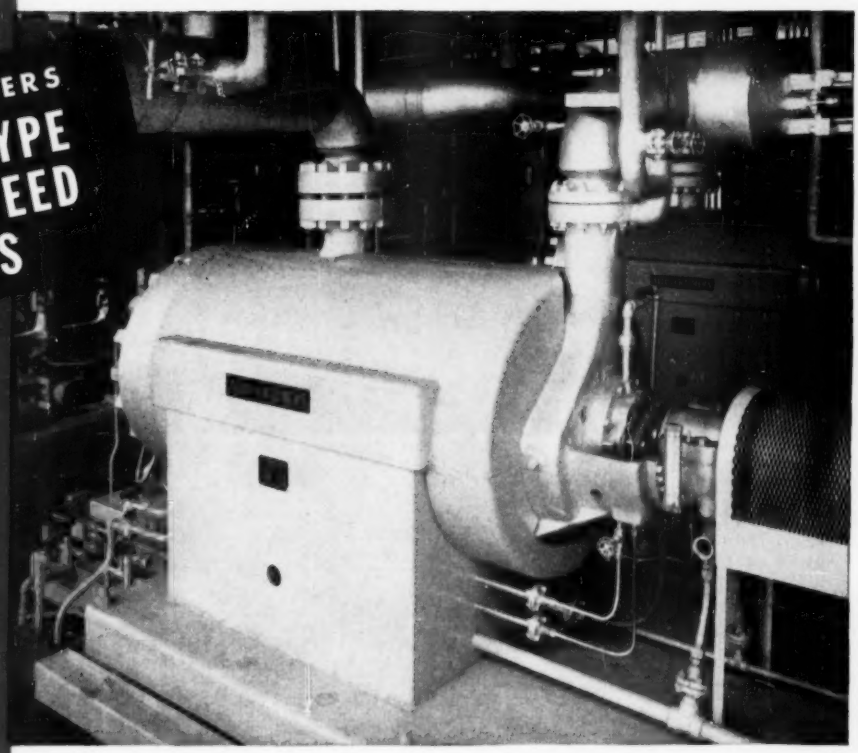
16—LENS SYSTEM, water-cooled, for industrial television

Designed to permit the use of the RCA industrial television camera for direct viewing of furnaces and other high temperature operations up to 3000 F, this water-cooled lens system is adapted to multiple camera installations. Using a high-efficiency closed circuit water circulating system, the lens reduces infra-red radiation and lens temperatures at the camera below 120 F, it is stated, giving stable camera operation.

Major components of the system include double-glass lens, heat exchanger, pump, and blower. The camera mount,

ALLIS-CHALMERS

BARREL-TYPE BOILER FEED PUMPS



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PROVED DESIGN FEATURES

Behind the A-C boiler feed pump stand many proved design features. For example: First stage has twin, single suction impellers to give low NPSH requirements for highest efficiency under fluctuating loads. Impellers mounted back to back balance axial forces without the need for a balancing drum. Expansion joint and seals are brought to the outside of the pump . . . they may be inspected often and worked on easily, if required.

COMPLETE UNIT FROM THE SOURCE

Allis-Chalmers can supply the complete pumping unit — pump, motor and control — all of coordinated design and manufacture. You get one responsibility — one guarantee of satisfaction.

Get complete information on Allis-Chalmers barrel-type boiler feed pumps. Call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wis., and ask for Bulletin 08B7899.

A-4328

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which supports the lens, is attached to the furnace casing. Side-mounting is used for observing direct-fired furnaces; top mounting for tangentially-fired furnaces. The mount permits ready access for cleaning the lens.

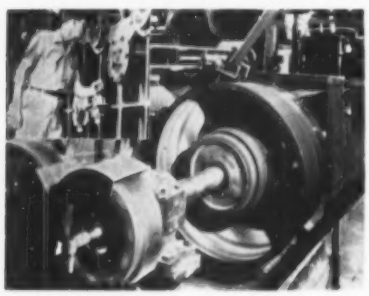
Water is circulated by the motor-driven pump in a closed system which includes lens, reservoir, and heat exchanger. Low pressure air, supplied by the blower, is directed against the furnace side of the lens for additional cooling, and for preventing an accumulation of combustion materials on the face of the glass. A portion of the air is diverted into two jets, one on each side of the camera, to reduce its ambient temperature. Radio Corp. of America.

17—THREAD COMPOUND is lubricant seal for threaded fittings

A single application of Big D Dope is claimed to provide a permanent lead-plating, island high, permitting repeated, quick assembly and disassembly of any size threaded connections without redoping and without damage to threads. According to manufacturer, the compound is anti-gall, non-corrosive, non-hardening and leak-proof, and is resistant to steam, gas, oil, air, chemicals, alkali, acids, ammonia and hydrocarbons. It is available in 2 lb pails at about 85 cents per pound; costs about 36 cents a pound if you order 80 lb. A sample is offered. C. H. Dragert Co.

18—AIR CLUTCH features quick action, ease of control

The Air-Grip responds instantly to a touch of the throttle because a minimum of air is used in its operation, manufacturer explains, and this sensitivity provides "finger-tip" control and an ability to "inch" the control or throw it into full engagement, as required. Instant disengagement of clutch is said

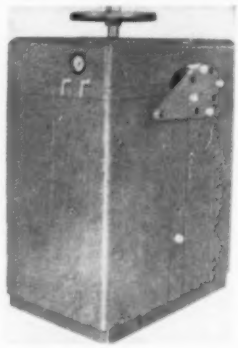


to be achieved by the use of quick release valves built into the clutch itself; these valves are optional equipment. The installation pictured shows the clutch operating on the drive of a pulp machine.

Engineering advances announced for the Air-Grip include provision for internal ventilation and a flexible air seal disc so located that it does not come in contact with the heat generating plates. These features are said to result in cooler operation and longer life. The Air-Grip also has provision for mechanical engagement of clutch in case air supply fails. Compact in size, this new clutch interchanges with and can be used to replace many mechanical clutches in existing installations. It is available in single and double plate models from 8.5 to 806 hp per 100 rpm at 80 psi. Dodge Mfg. Corp.

19—DRIVE UNIT positions fans, valves in outdoor boilers

This high torque final drive unit is announced for positioning fans and valves in outdoor boilers and heavy doors and other equipment in steel mills. Reported as capable of exerting



starting torque in excess of 4,000 ft-lb, it is enclosed in a weather-proof housing. A thermostatically controlled heater can be furnished, mounted inside the housing, to maintain proper temperatures in cold weather. The unit is pneumatically powered and may be equipped to receive either pneumatic or electric control signals from an automatic source or manually operated control panel. When furnished with an electric receiver, it can be used with company's Telemaster electronic combustion control system.

Rotary shaft output with 60 deg travel is designed to simplify linkage since a push-pull motion is available at any angle in increments of 45 deg about the shaft. In case of failure, manufacturer points out, the unit locks automatically in its last position. The lock is again reset when air pressure is restored. A handwheel manual station on the unit permits local operation in emergencies, and removable side covers afford access to inside parts for servicing. The unit is described in Specification Folio S-19. Republic Flow Meters Co.

20—PULL SCRAPER has three-piece reversible cutting edge

Model 108 is announced as a medium-sized, rubber-tired, pull scraper with a 8.4 cu yd struck and 11 cu yd heaped capacity. Cable operated, it is of welded box-type construction with an overall length of 27¼ ft, overall width of 10½ ft, and in load-carrying position, an 7′2″ ft height. Width of the cut is 8½ ft, with depth ranging to 10 in. Features of the unit include its three-piece reversible cutting edge, heat treated and hard faced for extra long wear; free floating type front apron, providing generous opening for loading all types of material; a low and wide bowl with curved bottom and smooth interior, and, for spreading, positive forced ejection. Tractor Div., Allis-Chalmers Mfg. Co.

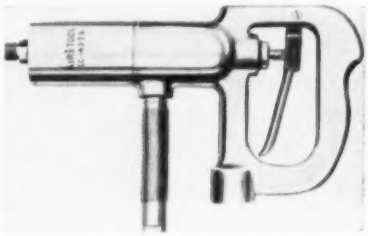
21—BIN LEVEL INDICATOR with built-in signal light

For use in installations requiring a signal which can readily be seen by an operator, the Model AL Special Bin-Dicator is described as a complete, visual signal system in one package and it comes assembled, ready for connection to a power source. It is declared as easy to install as company's standard Bin-Dicators, there being only one more terminal to connect. A toggle switch is provided so that the signal light may be shut off if desired.

This indicator costs only $12.50 more than the standard model without light, company points out, and this low price makes it more economical than any signal light hook-up a user would devise to serve the same purpose. It is reported especially suited for use on scale hoppers and small bins handling bulk materials. As in other Bin-Dicators, the switch mechanism is operated by a flexible diaphragm which is actuated by pressure of the material in the bin or hopper. Various diaphragm materials are available. The Bin-Dicator Co.

22—CONDENSER TUBE CLEANER is light and fast working

Condenser Tube Cleaner CC-4325 is described as capable of cleaning completely plugged tubes up to 1 in. ID and smaller. A major advantage, according to manufacturer, is its weight of only 11 lb



which permits it to be used by only one operator. The new cleaner is designed to operate at high speed and clean fast, has a muffler to reduce exhaust noise. It is claimed to be especially effective when used with the carbide tipped drill for cleaning hard deposits.

This cleaner has a built-in flushing system and quick shut-off valve for water feed. It is equipped with either regular handle or sleeve valve handle for controlling the flushing agent which also cools the drill. The air supply valve has a trigger to start and stop the piston, and also to regulate speed. The Airetool Mfg. Co.

23—WOUND-ROTOR MOTOR is enclosed, fan cooled unit

Announced as bearing the Underwriters' Laboratories label, this explosion proof motor is believed to be the first rib-type enclosed fan-cooled wound-rotor motor to be made with slip rings, brushing rigging, rotor and stator inside a single frame enclosure. It is available at 1800 rpm and slower speeds, in frames 284 to 505, in standard enclosed or explosion-proof construction. In general, the new motor is applicable where very low starting current, high starting torque, smooth acceleration, jogging or variable adjustable speed dictate the use of a wound-rotor motor — and where moist, dirty, corrosive or hazardous atmospheres require a totally enclosed one.

The frame of this motor has an extended front end to include the slip rings, brushes and brush rigging. The elongation provides added surface for heat dispersal. Removal of two large

One of many advantages of 90/10 Cupro-Nickel

WELDABILITY

Welding head on filter shell

One of the relatively new copper base alloys is 90/10 Cupro-Nickel, which is coming into increased use as a result of experience with it. Revere offers it in sheet and plate, pipe and tube. It is highly resistant to corrosion and erosion, particularly in salt or brackish water. In addition it can be cold or hot worked, welded, soldered and polished. Because its nickel content is less than the older 70/30 alloy, it is priced lower.

The item shown here is a 90/10 Cupro-Nickel filter for aviation gasoline, designed and fabricated by the Warner Lewis Company, Division of Fram Corporation, Tulsa, Oklahoma, for the U. S. Navy. Heads and shell are 1⅛" thick. Revere was given the opportunity to collaborate with the Warner Lewis manufacturers on welding, which was successfully accomplished by the metallic arc process, using Incc 70/30 Cupro-Nickel electrodes. The vertical weld on the shell was X-rayed 100% and found satisfactory to pass Navy inspection. Because of the thickness of the metal, it was decided to form the heads hot at around 1690° F. The forming was done by the Hackney Iron & Steel Co., Enid, Okla., which also consulted with Revere.

Warner Lewis Company of Tulsa, with representatives in 30 cities, are specializing on all types of alloy design and fabrication and inquiries of this nature are invited.

If you wish information regarding the selection, welding, or working of copper and its alloys and aluminum alloys, see the nearest Revere Sales Office.

Completed aviation gasoline filter, made of 90/10 Cupro-Nickel

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SEE "MEET THE PRESS" ON NBC TELEVISION, SUNDAYS

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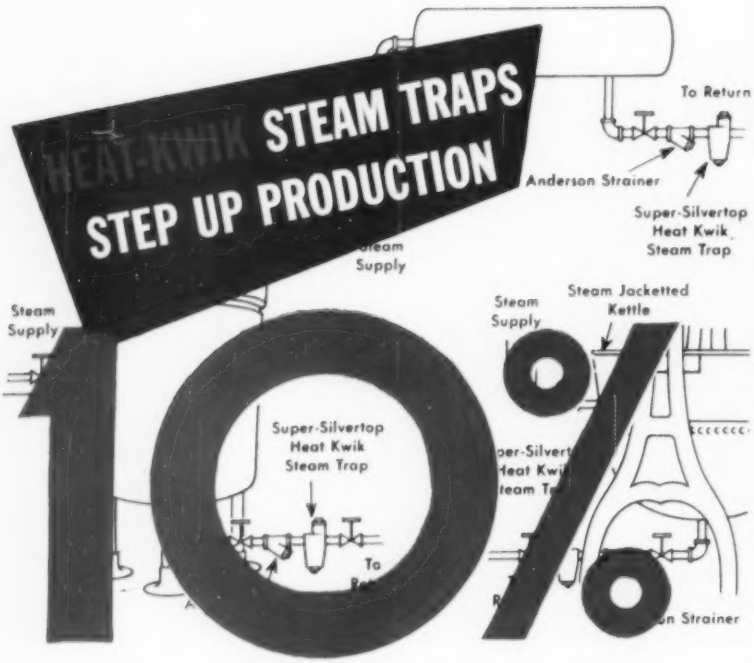

ON STEAM UNITS!

Would you be interested in obtaining 10% more production from your steam jacketed kettles, autoclaves, dryers and other steam units? Of course you would. And you can . . . if you replace old traps with the revolutionary new Super-Silvertop Heat-Kwik steam traps. These new Anderson traps are a combination open float and thermostatic trap that vent air out of steam units several times faster than ordinary inverted bucket or blast-type traps.

This means when your production units are first started up . . . or between batches . . . the air is quickly siphoned off, permitting hot steam to fill the unit with extreme rapidity. It pays production-wise and economy-wise to put Heat-Kwiks on all steam production units. See your distributor or mail coupon for his name.

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pipe plugs from the upper quadrants of the frame on the slip-ring end provides large openings for maintenance work, adjustment of brushes. Slip-ring leads enter a separate cast-iron conduit box and the lead opening in the frame is sealed. Construction features are described in Leaflet 51R8195. Allis-Chalmers Mfg. Co.

24—SMOKE VIEWER lets you check density of smoke plume

Besides helping a power plant to comply with smoke control laws, the SMA Smokescope can be used to determine whether fuel is being properly burned, since excessive smoke indicates that it is not. With the Smokescope you can view a standard reference disk, shaded to correspond with degrees of smoke

density, against the background of a smoke plume. Here's how it works: Light from the area adjacent to the stack is transmitted through one tube of the instrument and through the reference film disk inside the tube to a front surface mirror. Reflected by the mirror, it passes through a lens to an image mirror where it may be directly compared with the smoke as seen through the other tube of the instrument.

The lens used to project a virtual image of the reference film disk also serves to intensify the light in the reference standard optical path to compensate for light loss at the reflecting surfaces. It is pointed out that the Smokescope overcomes some of the disadvantages of the "chart system" in that its design eliminates possible interference of ambient light and there is no need to shift the eye from smoke to chart. Mine Safety Appliances Co.

25—TRANSMITTER is remote pneumatic instrument

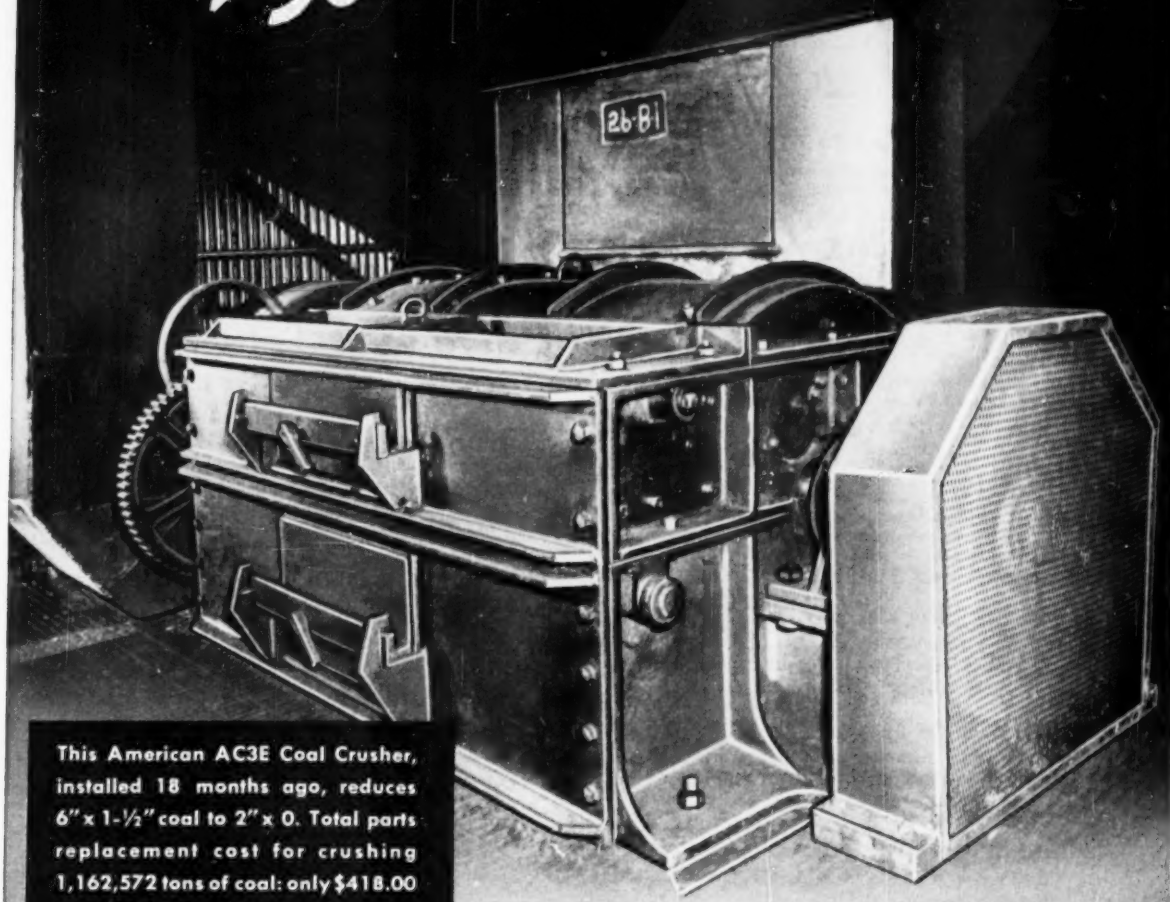
The Laminair is designed to permit location of instruments at greater distances from primary devices without regard for hydraulic elevations at the point where the instruments are located. The mechanism balances a single air pressure against any differential pressure produced by a venturi tube, flow nozzle, orifice plate, or the difference between two existing levels or pressures, which pressure is then transmitted and used by a distantly located instrument. Two groups of mechanism control the device — the differential converter which converts the fluid pressure to air pressure, and the bellows type receiving mechanism which translates air pressure into terms of measurement for application to a flow or pres-

AMERICAN ROLLING RING CRUSHER

Reduces 1,162,572 Tons of Coal

...at parts replacement cost of

1/30th of a cent per ton!



This American AC3E Coal Crusher, installed 18 months ago, reduces 6" x 1-½" coal to 2" x 0. Total parts replacement cost for crushing 1,162,572 tons of coal: only $418.00 or 1/30th of a cent per ton.

"When You Figure Cost Per Ton... the Best Answers Come From American"

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

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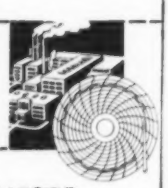
1 *Steam* + CORAVOL® = *Protection* (FROM CORROSION)

CORAVOL circulating throughout your steam system protects it from corrosive attack; cleans out rust deposits; increases heating and operating efficiency; reduces maintenance and labor costs. CORAVOL is the *original amine process* developed by Western Chemical Company.

2 WESTERN BOILER FEED WATER TREATMENT

Special formulas for each individual boiler water and operating condition to eliminate scale, corrosion and foaming.



3 COOLING WATER TREATMENT AND ALGAECIDE

Prevents scale deposit, corrosion, and algae growth in every type of cooling and condenser water system.

4 BRINE AND SWEET WATER TREATMENT

Prevents corrosion and protects tanks and equipment in refrigerating brine and sweet water systems.

5 WESTO HOT WATER TREATMENT

Stops corrosion and scaling in hot water supply tanks and lines, maintaining service without impairing potability.

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Disintegrates and removes scale quickly from water jackets, cylinder heads, condensers, compressors, lines, coils, pumps.

7 WESTERN ALUMINA NO. 45

Provides efficient coagulation in raw water ice manufacture, lime and soda softeners, water supply clarification.

8 WESTERN SOOT REMOVER

Removes and prevents soot deposits in combustion areas, thus increasing fuel economy and boiler capacity.

9 WESTERN FUEL OIL SLUDGE DISPERSANT

Eliminates sludge and moisture in fuel oil, effecting clean tanks, lines, and burners, and improved combustion.

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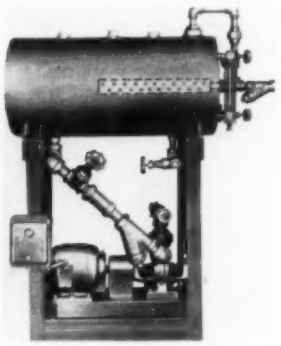
sure indicating or recording instrument. Since air consumption for each converter is reported to average only 0.1 cmf of free air, the Laminair is economical in action. A small self-contained air compressor having but a few cu ft capacity will be sufficient for the average community filter plant or meter installation. Simplex Valve and Meter Co.

26—BOILER FEED SYSTEM incorporates a pre-heater

A boiler feed system, incorporating a pre-heater that operates on steam from the boiler is announced for use with steam boilers. The units are designed to automatically maintain boiler feed water between 190 and 200 F. Tank sizes range

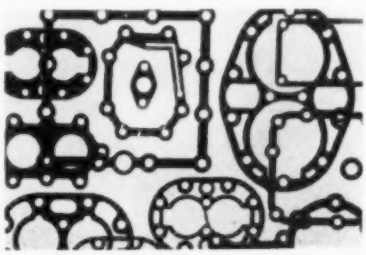


from 30 to 540 gal, and they will supply from 280 to 2800 gal of heated water every hour. Company engineers point out that pre-heating boiler water lengthens boiler life by eliminating stresses caused by low temperature feed water entering the already heated boiler shell. Pre-heating makeup water also helps boiler maintain pressure during peak periods and reduces boiler scale.

A perforated tube inserted horizontally in feed water tank is connected to the steam supply. The unit is thermostatically controlled so that steam is allowed to enter only when the temperature falls below a predetermined point. A thermostatic bulb filled with a pressure-sensitive fluid controls a flexible bellows that mechanically opens and closes the valves, varying the opening or completely closing it. Cyclotherm Div., United States Radiator Corp.

27—SHEET PACKING for air conditioning, refrigerating

R/M R-54 is a compressed asbestos sheet packing for head gaskets on refrigeration compressors developed solely for air-conditioning and refrigeration uses, and claimed to seal effectively against



Freon-22, as well as all other Freons. The binder in R-54 is a new type of Neoprene which has been specially extended, manufacturer explains, and 70

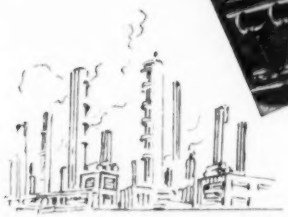
THIS 400,000 Pounds per HOUR

Vogt

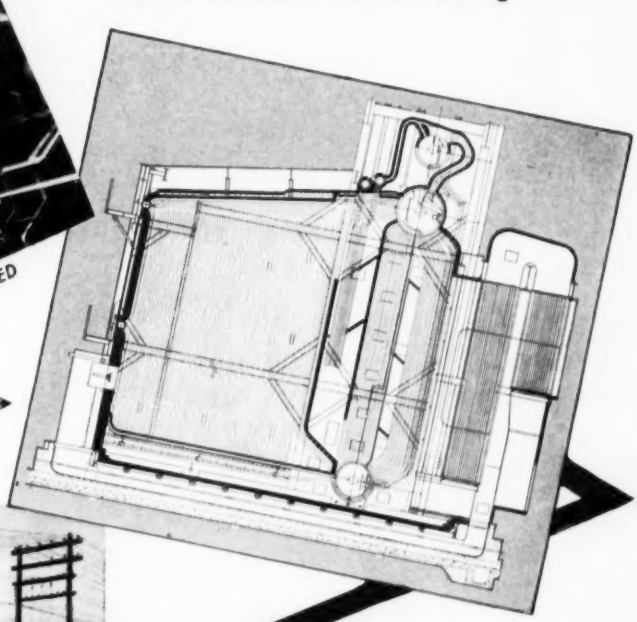
STEAM GENERATOR

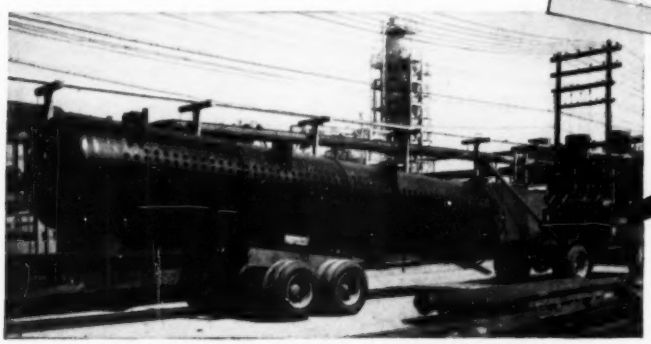
Gives Top Performance in a Leading Texas Petroleum Refinery

VIEW OF THE COMPLETED STEAM GENERATOR



RIGHT → LONGITUDINAL SECTION THROUGH THE UNIT.





6'-6" DIAMETER x 37'-0" LONG STEAM DRUM BEING TRANSPORTED TO THE ERECTION SITE DURING INSTALLATION.

PRINCIPAL DATA

400,000 pounds per hour capacity.

Fusion welded steam and water drums designed for 700 lbs. S.W.P.

Superheater delivers steam at 750°F. total temperature.

Water cooled furnace.

Burners for Oil and Acid Sludge fuel.

Vogt builds a complete line of bent tube steam generators designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Write for bulletins.

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NEW "Small" boiler is a Big Quality package!

Available up to 150 hp — heating or processing — steam or hot water. A complete unit from a single source.

CLEAVER-BROOKS modern C-B boiler

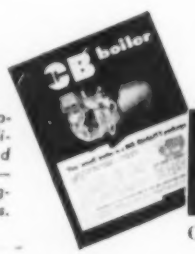
NO BOILER HAS EVER OFFERED SO MANY ADVANTAGES AND QUALITY FEATURES AT SUCH LOW INITIAL COST

• This NEW CB boiler has EVERYTHING needed to bring *big boiler standards* to commercial, industrial and institutional users with small capacity requirements. Despite its unusual, compact size you get big boiler performance — from matched-quality components, proved the world over on thousands of Cleaver-Brooks self-contained units.

Get all the facts NOW on how the new CB can help you save dollars. Make it a point to see . . . and *hear* the most silent-running, biggest boiler value available anywhere!

•

Call your nearest CB boiler representative (see your phone directory) or send for this illustrated catalog describing the NEW CB — designed by Cleaver-Brooks, originators of self-contained boilers.



gives you all the quality features of time-tested self-contained design

- **FOUR-PASS FIRETUBE CONSTRUCTION** — longer gas travel scrubs heat from flame — means lower fuel costs — guaranteed efficiency of 80% when firing with oil.
- **SILENT OPERATION** — even at peak load this boiler more than meets the low sound levels required for schools, hospitals, institutions.
- **FULL FIVE SQUARE FEET** — of heating surface per boiler hp — for longer service life and low maintenance.
- **FUEL FLEXIBILITY** — burns available light oil, gas, or combination oil/gas — simple, quick fuel changeover on oil/gas models.
- **FAST, EASY MAINTENANCE** — front and rear doors hinged for fast inspection, cleaning or servicing boiler.
- **AUTOMATIC SAFE OPERATION** — all controls centralized and conveniently located — modern electronic combustion control is standard equipment.
- **COOLER BOILER ROOM** — fiber glass blanket insulation and 16 gauge metal sectional lagging are non-corrosive, moisture and heat resistant.
- **FULLY APPROVED** — by Underwriter Laboratories; conforms to ASME codes; factory tested before shipment.

NOW—FIRST SIZES OF THE CB BOILER ARE MADE IN CANADA, TOO.

Cleaver Brooks

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Cable Address: CLEBRO — Milwaukee — All Codes.

Originators of the Self-Contained Boiler

For more data circle 537 on Post Card

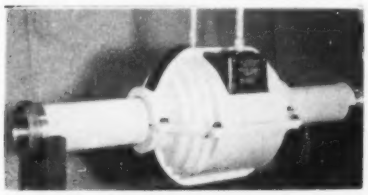
to 75 per cent of the sheet is asbestos — uniformly opened and coated prior to the sheeting procedure.

According to company, the binder used swells when in contact with the refrigeration oil in the Freon, to assure a tight seal on the flange and fill all spaces. The new sheet also has a higher compression than many compressed asbestos sheets, which, it is noted, helps to correct improper flange design and requires lower bolt loadings. R-54 is furnished in standard thicknesses of 1/64 through $\frac{1}{8}$ in. and in 11 sheet sizes from 40-by-40 in. to 150-by-150 in. Packing Div., Raybestos-Manhattan, Inc.

28—MAGNETIC METER for larger lines and unlimited flows

For 2- to 8-in. flow lines, this electromagnetic meter is announced as incorporating all advantages of electromagnetic metering and as being additionally rated for unlimited maximum flows. It is designed to measure the volume flow rate of any liquid of sufficient conductance and velocity. Said to be unaffected by the pressure, viscosity, density or changes in conductivity of the flowing liquid, it is suggested for aqueous solutions, slurries, acids and other corrosives, also food products.

The unit consists of a nonmagnetic flow tube with an insulating liner containing flush-mounted metallic electrodes and surrounded by an a-c electromagnet. When conductive liquid passes through

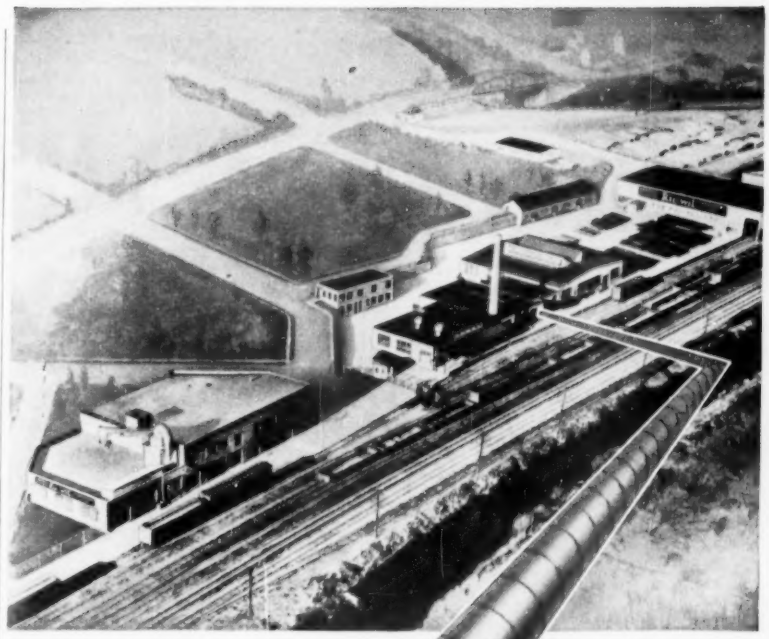


the tube, an alternating voltage is set up between the electrodes which varies linearly in proportion to the rate of flow. Lead wires from the electrodes transmit this voltage output to a new type of electronic recorder, producing a chart record in appropriate units of flow. Specifications are in Technical Report TI 27-A-71a. The Foxboro Co.

29—FHP MOTOR is totally enclosed, shaft-mounted unit

This totally-enclosed fractional horsepower motor for shaft-mounted fans and blowers, weighs 50 per cent less than company's previous models. The light weight and small size of this motor save assembly and handling expense and provide maximum power in minimum space, according to company engineers. The new design has extended through bolts which provide a solid mounting face beyond the surface of the end shield.

The single- and two-speed, totally-enclosed, fan-cooled motor is designed especially for dependable, continuous service under severe conditions of dust and dirt. Filtered oil keeps bearing surfaces clean in the quiet all-angle sleeve bearings, company says, and an extended oiler on the shaft end assures long service regardless of mounting position. For applications having moderate thrust, the motor comes in one- and two-speed single-phase models and in single-speed polyphase models, with ratings to $\frac{1}{2}$ hp. General Electric Co.



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Quality

The Ric-wil Company represents over 40 years of manufacturing Quality Insulated piping systems. The complete Ric-wil product line is continuously pre-proven by laboratory and field tests to maintain this superior quality.

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Quality Piping Systems of the . . .
. . . Highest Thermal Efficiency

RIC-WIL PREFABRICATED INSULATED PIPING SYSTEMS

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BARBERTON, OHIO

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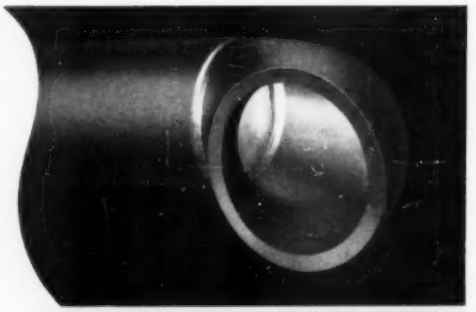
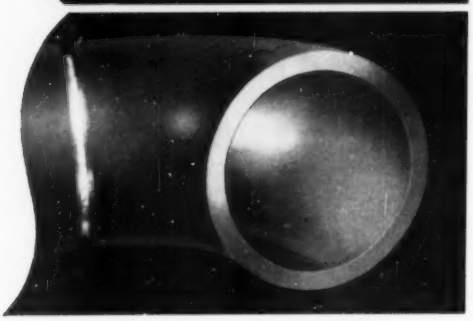
INERT GAS TUNGSTEN ARC-WELDING ON HIGH-TEMPERATURE, HIGH-PRESSURE PIPING?

It's More a Matter of Skill Than Inert Gas Back Pressure

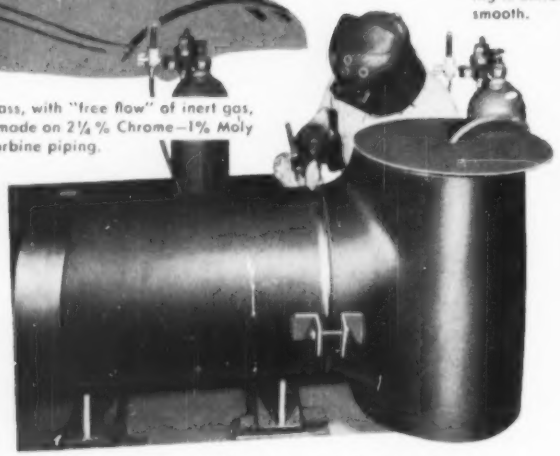
Inside bead surface of root pass on 2¼% Chrome–1% Moly steel turbine connection produced by P.P.&E. inert gas tungsten arc-welding is uniform and smooth.





Typical external surface of root pass produced by skillful inert gas tungsten arc-welder.

Root pass, with "free flow" of inert gas, being made on 2¼% Chrome–1% Moly steel turbine piping.



Inert gas tungsten arc-welding is one of many operations involved in the fabrication of high-temperature, high-pressure piping. Like the others its success is not assured by a single factor, but comes as a result of long experience with all manufacturing techniques and service requirements of power piping.

Simply protecting the internal surface of the root bead with inert gas under "control" does not take the place, for example, of skillful welding.

Pittsburgh Piping's process provides an inert gas shield against the atmosphere on both internal and external surfaces of the root pass. This procedure, combined with other P.P.&E. techniques, eliminates need for backing rings and double butt welding, and produces a sound, clean joint having a remarkably uniform root bead of correct internal contour.

Applicable to all types of power and process piping—inert gas tungsten arc-welding is another of the many advanced P.P.&E. techniques used in producing all types of power piping—as small as control lines, as large as steam mains.

Pittsburgh Piping AND EQUIPMENT COMPANY

10 Forty-Third Street—Pittsburgh, Penna.

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Boston.....10 High Street	Los Angeles..1830 N. Alexandria Ave.
Chicago.....Peoples Gas Building	New Orleans.....P. O. Box 74
Cleveland.....Public Square Building	New York.....Woolworth Building

PP-5

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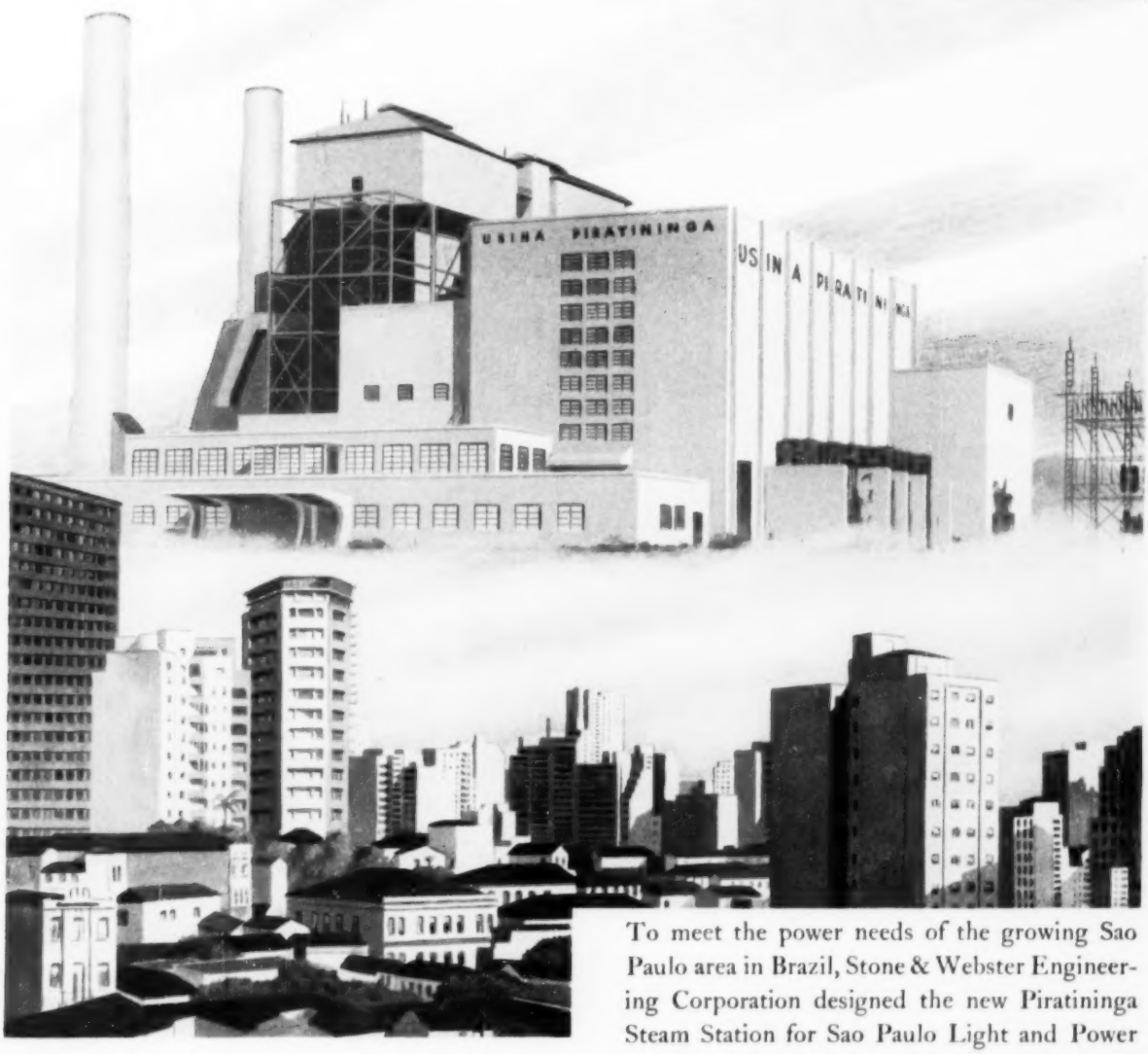
Piratininga Steam Station houses two 100,000 kilowatt capability turbine generators, each with its own boiler, these being the largest generator units ever shipped to South America.



ACHIEVEMENT IN BRAZIL . . .

To meet the power needs of the growing Sao Paulo area in Brazil, Stone & Webster Engineering Corporation designed the new Piratininga Steam Station for Sao Paulo Light and Power Company, Limited, an operating subsidiary of the Canadian corporation, Brazilian Traction, Light & Power Company, Limited. Construction for the first unit, now in operation, was completed in a record time of 26 months by Stone & Webster Construction Company.

All available materials were purchased in Brazil, and the field forces, totaling over 1800 at the peak of construction, were recruited locally.

Write or call us for detailed information as to how our engineering, design, construction, report and appraisal services may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

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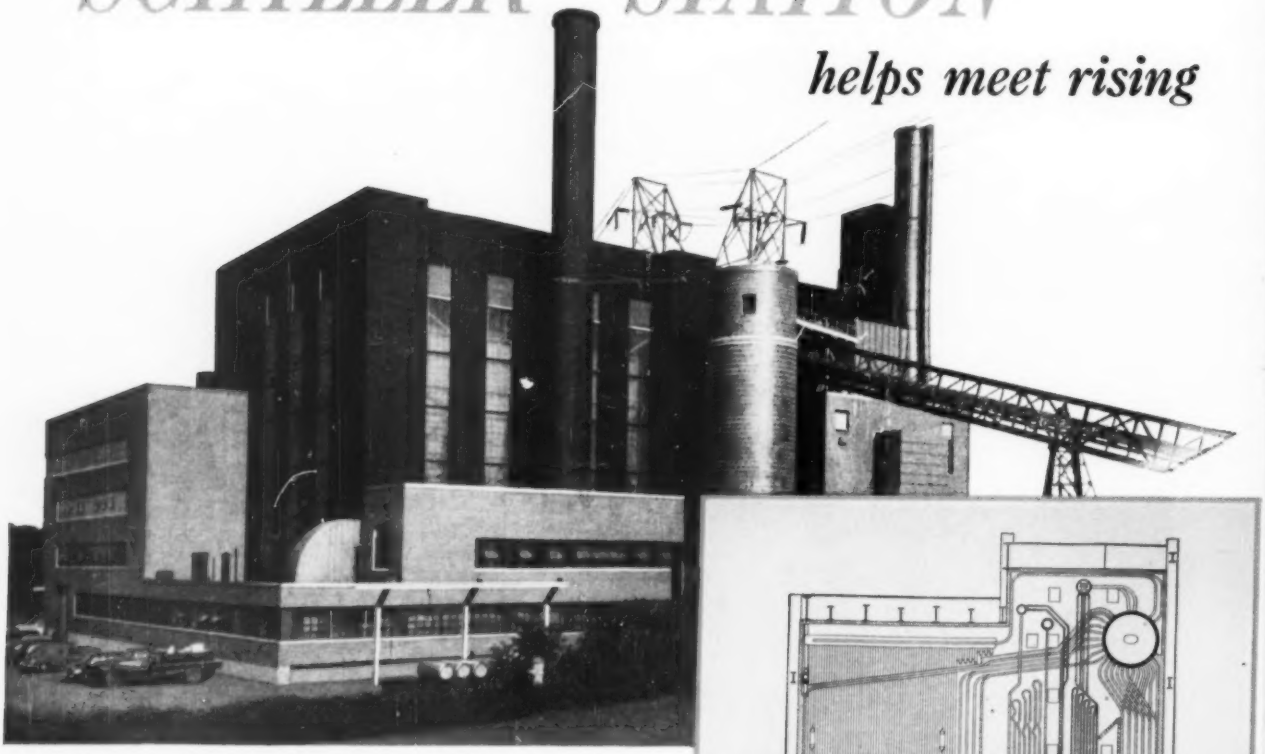
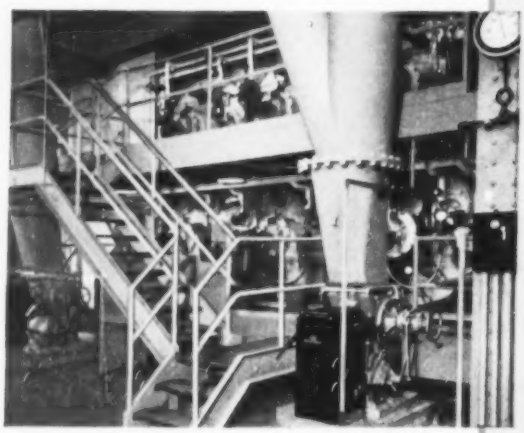
SCHILLER STATION

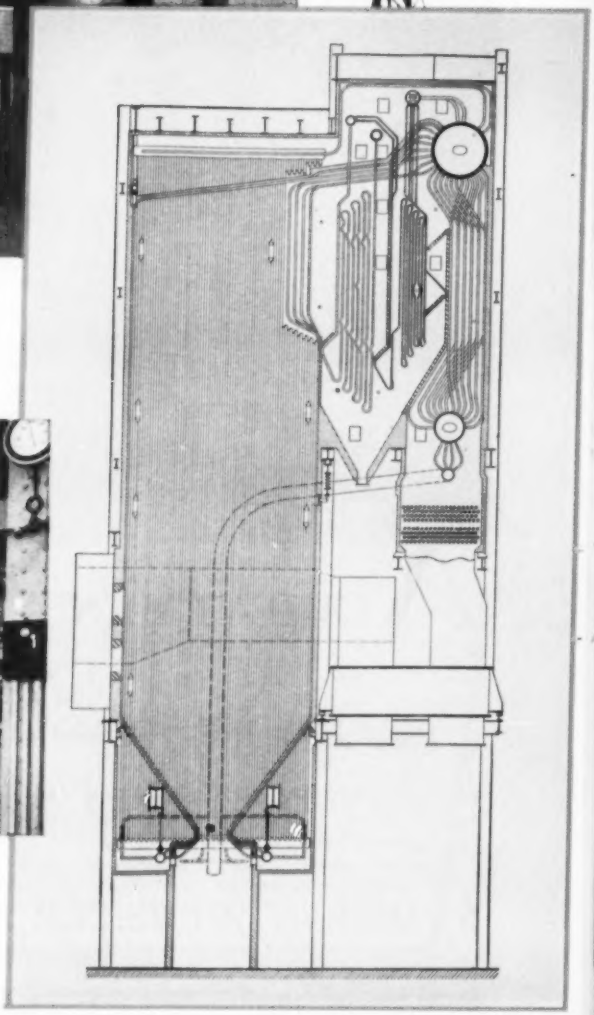
helps meet rising



Looking east toward Schiller Station and the Piscataqua River. Addition housing FW steam generator now being erected on the right of the present structure. Consulting Engineers: Jackson & Moreland, Boston, Mass.



View showing oil burners serving Foster Wheeler boiler. Fuel consumption 65 gallons of oil per minute.



Cross-section of one of two identical Foster Wheeler 2-drum steam generators at Schiller Station, Portsmouth, N. H. Design pressure 1475 psig, final steam temperature 950F peak capacity 450,000 lbs per hr.

demand for electric service in New Hampshire

Foster Wheeler 450,000 lb per hr steam generator, installed in Schiller Station of Public Service Company of New Hampshire, has augmented station's capability by over 50,000 kilowatts. A second Foster Wheeler unit, now under construction, will contribute an additional 50,000 kilowatts to the rapidly growing power-producing facilities of this business-managed utility.

Reddy Kilowatt

SCHILLER STATION of Public Service Company of New Hampshire was first opened in 1950. But, to meet the ever-growing demand of New Hampshire's thriving industries, farms and homes, in the four short years that have passed, Public Service has found it necessary, upon two occasions, to increase the power-producing facilities of this station.

In the first addition, a two-drum Foster Wheeler steam generator — complete with superheater, economizer and waterwalls as shown in the accompanying cross-section — was installed. This added 50,000 kilowatts to the station's capability. For the second addition, now being constructed, an identical Foster Wheeler steam generator is specified that will contribute an added 50,000 kilowatts.

This installation is another example of Foster Wheeler's ability to design and construct equipment to meet exacting power-producing needs — equipment that reflects the engineering ingenuity of an organization long recognized as a pioneer in the field of steam generation. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

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FOSTER WHEELER

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New Automatic cold draw bench

Makes Monel tubes up to 85 feet long for high pressure feed water heaters

A new $1,250,000 cold draw section is now in operation at the Huntington Works of The International Nickel Company, Huntington, W. Va.

The unit triples former capacity for producing heat exchanger tubes. In addition, it extends length limitations on some Monel® tubes. They can now be drawn up to 85 feet in length, thus enabling designers to take advantage of greater heating area in tube bundles, and to effect economies by specifying *longer* heaters of *smaller* diameter.

A feature of the new draw bench is an unusual magazine loading device. It consists of a revolving cylinder with a double set of three mandrels. As shown in the photograph, the upper set of mandrels can be loaded for the next draw while three tubes are drawn from the lower set. There's no slowdown, no time wasted.

With the new facilities in full operation, prompt deliveries of your Monel tube requirements are assured. Meanwhile, find out more about the many advantages Monel offers. It can, for example, help you improve heat transfer . . . extend exchanger life . . . reduce maintenance costs. Write us — now — for a copy of the bulletin, *Engineering Properties of Monel*. It's yours on request.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

More Power for you...with Monel INCO TRADE MARK **Nickel Alloys**

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Utility company in Texas successfully combats corrosion with U. S. Uscolite Pipe in 6 of its plants

All 6 plants use chlorine to control slime growth in "cooling water." One of the 6 plants (shown below, in Corpus Christi, Texas) also uses chlorine to control marine growth in sea water used exclusively for cooling. In addition, this plant uses Uscolite pipe to combat another enemy—high salt content of soil which corrodes metal pipe from outside and causes failure. These are the reasons why the utility company changed from iron pipe (which lasted only 4 years) to Uscolite® pipe, which is expected to last 30 years. Unlike other piping, Uscolite is not attacked by chlorine or most chemicals, or even sea water.

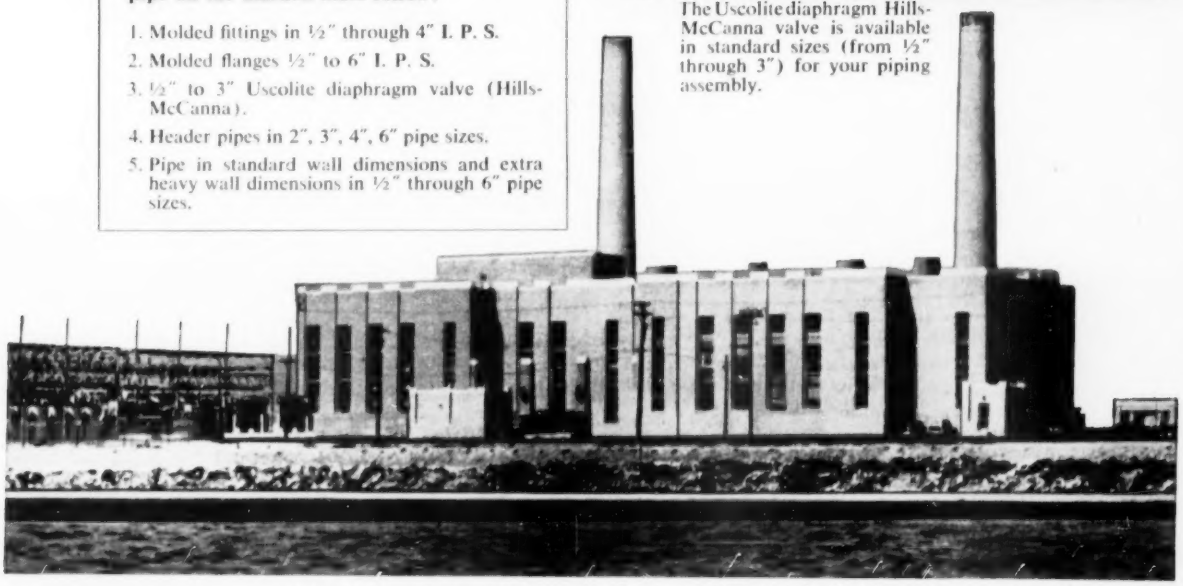
Uscolite is manufactured exclusively by United States Rubber Company. It has extremely high impact strength, high endurance, needs absolutely no maintenance, is very lightweight. It is available in standard lengths, and can be cut to length and threaded on the job.

Uscolite is the answer to corrosion and maintenance problems in piping. Any of the 27 "U. S." District Sales Offices will provide complete assistance and facts. Or write to address below.

Uscolite pipe and fittings come in the broadest and largest line of stock sizes of plastic pipe on the market. Sizes follow:

1. Molded fittings in ½" through 4" I. P. S.
2. Molded flanges ½" to 6" I. P. S.
3. ½" to 3" Uscolite diaphragm valve (Hills-McCanna).
4. Header pipes in 2", 3", 4", 6" pipe sizes.
5. Pipe in standard wall dimensions and extra heavy wall dimensions in ½" through 6" pipe sizes.

The Uscolite diaphragm Hills-McCanna valve is available in standard sizes (from ½" through 3") for your piping assembly.



*Above is photo of one of the plants, owned by Central Power & Light Co., Texas

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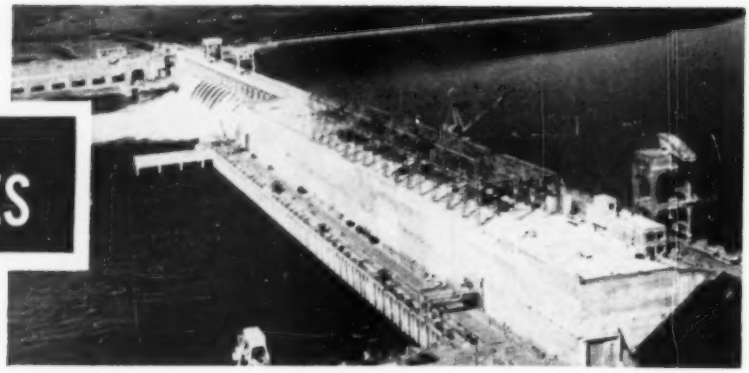
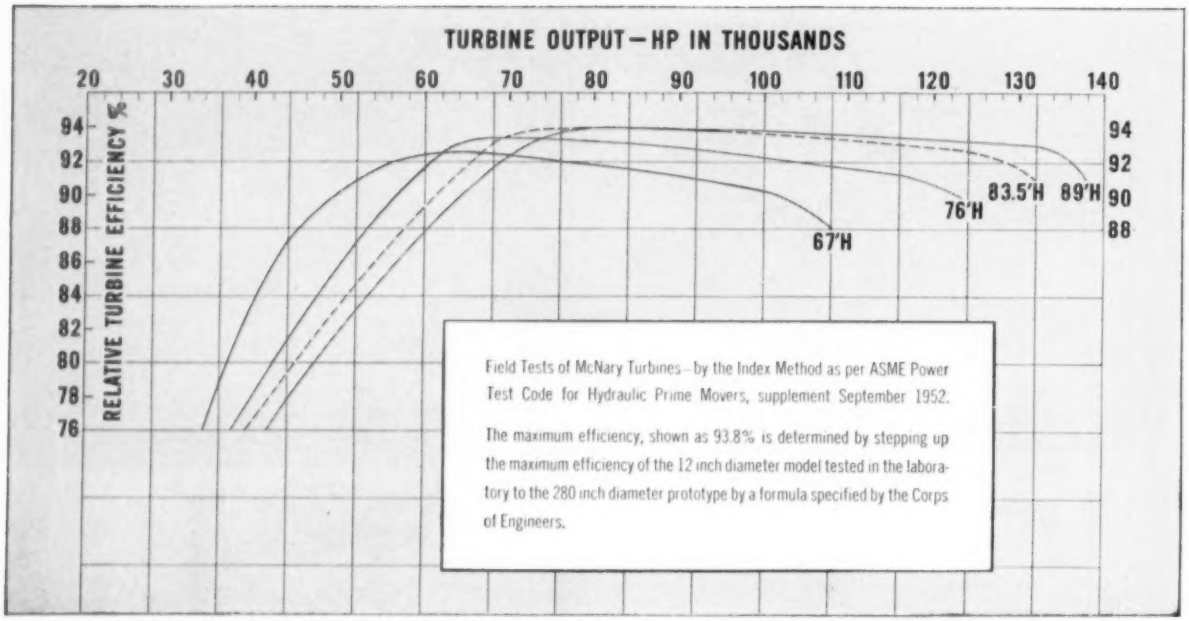
SMS

KAPLAN TURBINES




TURBINE OUTPUT—HP IN THOUSANDS
20 30 40 50 60 70 80 90 100 110 120 130 140
RELATIVE TURBINE EFFICIENCY %
94 92 90 88 86 84 82 80 78 76
94 92 90 88
67'H
76'H
83.5'H
89'H
Field Tests of McNary Turbines—by the Index Method as per ASME Power Test Code for Hydraulic Prime Movers, supplement September 1952.
The maximum efficiency, shown as 93.8% is determined by stepping up the maximum efficiency of the 12 inch diameter model tested in the laboratory to the 280 inch diameter prototype by a formula specified by the Corps of Engineers.

SMS-KAPLAN TURBINES AT McNARY DEVELOP 138,000 HP

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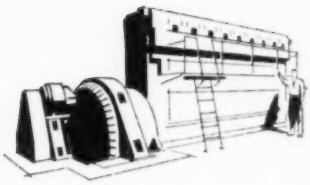

"Cured... bearing failure in their diesel-driven, front-end loaders"

A large fire-brick manufacturing company in the Philadelphia area had the problem of premature bearing failure in its diesel-driven loaders and shovel.

Headlights on even in daylight...

Sinclair Lubrication Engineer Harry Donovan reports, "These units were operating around the clock under conditions *so dusty that headlights were required.* Crankcases had to be drained and flushed bi-weekly! My first recommendation was closer adherence to an air filter maintenance program."

Drain intervals doubled!

Mr. Donovan continues, "Further observation proved to me that excessive idling and overloading were all contributing factors to a severe sludge condition. I recommended Sinclair SUPER TENOL® – explaining that the superior quality of the base oil plus the Sinclair formulated additives would extend bearing life *while at the same time removing accumulated lacquer and sludge.* A trial period proved SUPER TENOL doubled drain intervals and eliminated flushing entirely. This company now uses Sinclair SUPER TENOL exclusively."

Why not give a Sinclair Lubrication Engineer the chance to solve *your* lubrication problems? *There's no obligation.* Contact your local Sinclair office or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR LUBRICANTS

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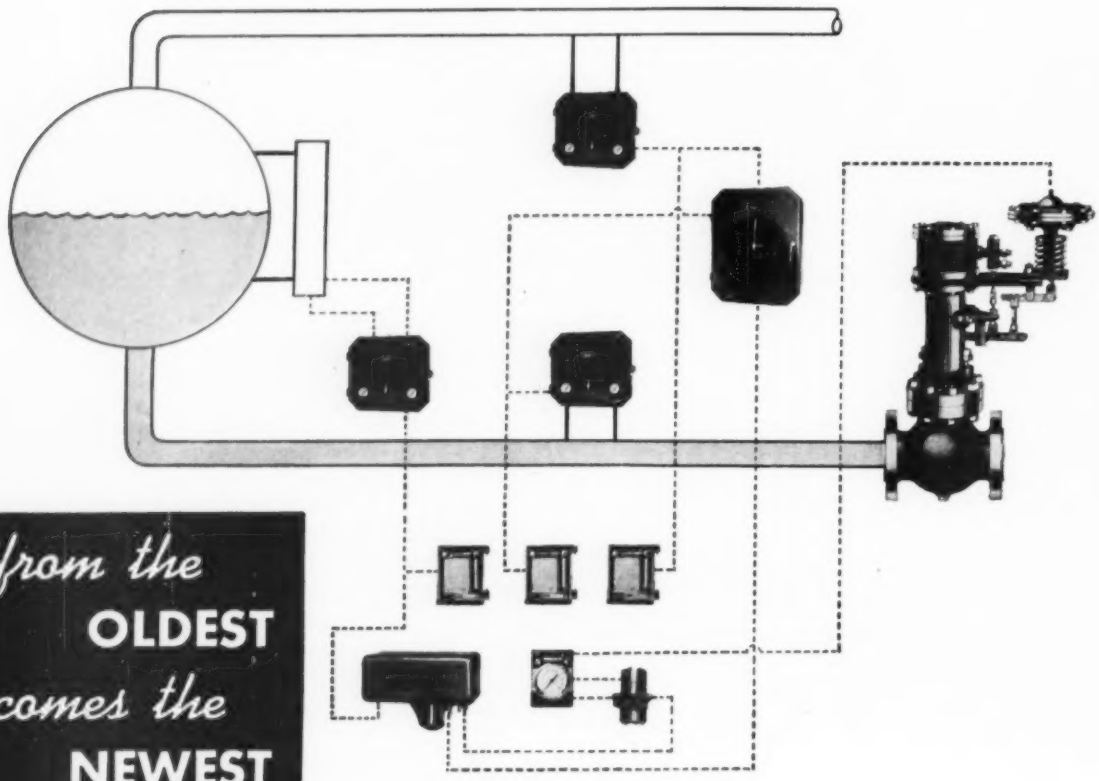

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Type 3-L with instrumentation by Taylor

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. . . the scientific balance, characterized ports and rugged dependability of the COPES control valve.

. . . plus the unequalled responsiveness and accuracy of *instrumentation by Taylor*.

And Copes-Vulcan assumes undivided responsibility for service, whenever or wherever needed . . . throughout the life of the installation.

Write for Bulletin 1013. It tells the story of the newest feed water control to come from COPES . . . the oldest name in boiler feed water regulation.

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COPES VULCAN

BOILER CONTROL

Three-influence mechanically-operated and three-influence electrically-operated regulators are also available.

WITH INSTRUMENTATION BY *Taylor*

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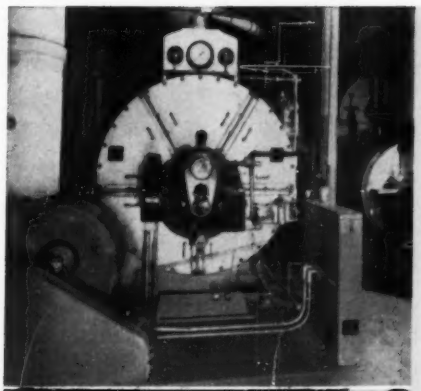


LUGGAGE WORKS

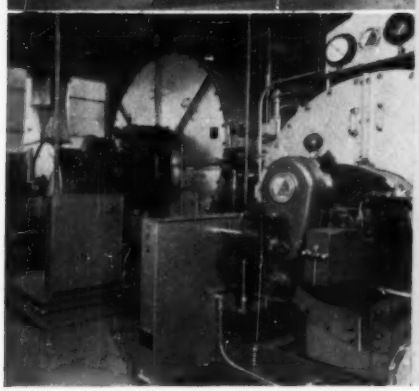
This 150 HP Preferred Unit Steam Generator, burning #6 oil, heats 200,000 sq. ft. plant. Replaced two 90 BHP "package" boilers burning #2 oil. Saves 50% in fuel costs.

METAL PRODUCTS PLANT

First ordered two 150 HP Units. Their dependable, economical performance soon led to another . . . then a fourth . . . and a fifth, all in less than 5 years.

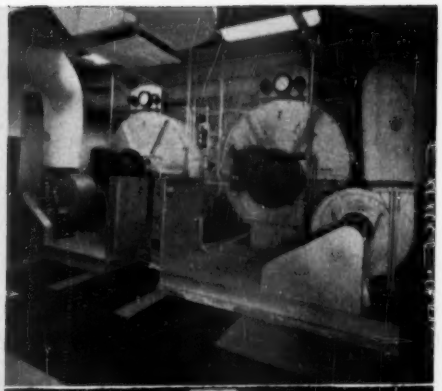
BURLAP & BUCKRAM PLANT

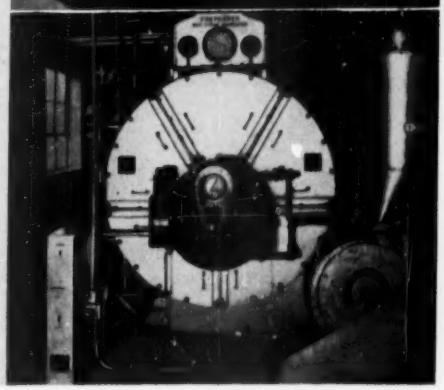
"I can't remember any maintenance that has cost us any downtime, or any cash. We have saved a considerable amount of money on steam expense. Very pleased about ease of operation of these units."



LARGE DAIRY

"Reliability and a minimum of maintenance are of prime importance and, with our Preferred Unit Steam Generator, we have achieved this goal . . . The low stack temperature that is consistently below your guarantee is a constant reminder that we are sending a minimum of heat up the stack."





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Experience proves that for economical, trouble-free, long-life service – no "package" boiler matches the performance quality and important engineering "extras" of the Preferred Unit Steam Generator.

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1. Four Pass, High Velocity Gas Travel assures maximum heat absorption.
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Your plant will profit from the advantages these built-in Preferred design features offer. Bulletin 2000 tells why. Write for a copy.

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The Quality Boiler You Can Count on for 25 Years of Economical Service.

Made in sizes from 20 to 600 BHP; 15 to 250 psi. Factory fire tested before shipment.

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Cut-away section of Yarway Impulse Steam Trap showing only moving part, a small stainless steel valve.

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Let's not kid ourselves . . .

Russian Technology Is Very Good

NATIONAL DANGER was stressed at the opening of the 1954 Fall General Meeting of the AIEE in Chicago. In his address entitled Technology in Defense, Donald A. Quarles, Assistant Secretary of Defense, emphasized that the arms race in which we are now engaged is one of technology rather than a mere piling up of armaments. And the frightening thing is that we are not winning the race. True we are out in front; but our margin of lead is small, and the gap is being cut down fast. The Russians are turning out more engineers and scientists than we are; theirs are better trained than ours; they are turning out more teachers to train more engineers; and their advances in technology in recent years have been phenomenal.

Several psychological difficulties prevent people from realizing the danger. For years we have thought of the Russians as a primitive, backward, and mechanically inept people. Evidence to the contrary does not easily change this long-held view. We minimize Russian technical achievements. We say the only good scientists in Russia are German; that Russian designs are copied from captured Allied equipment; that they get their information from espionage, and so on —anything to avoid the painful admission that the Russians have large numbers of first-class scientists and engineers and that there's nothing phony about their technical achievements.

The Russians themselves are partly to blame for this disbelief in their progress. Their occasional ridiculous claims to have invented just about everything from paper to penicillin makes us doubt their claims when they are really true.

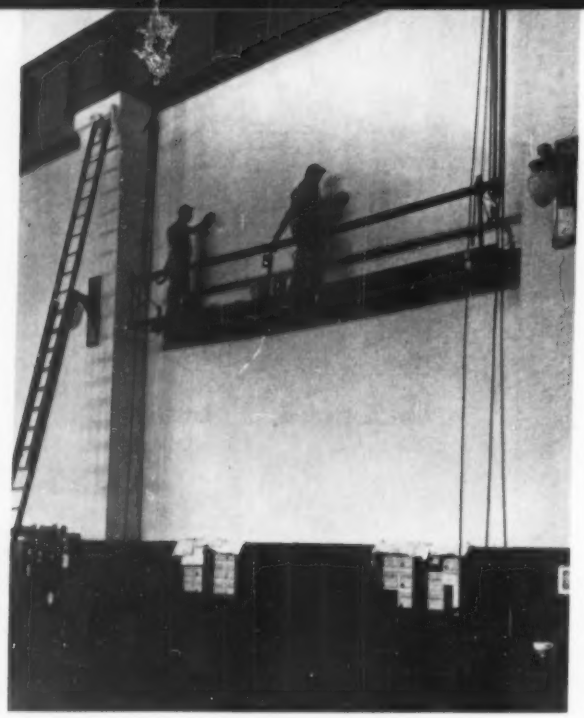
We are often told that the American boy grows up with mechanical gadgets and so acquires a natural aptitude for engineering, and that Russians see few mechanical devices and so lack this engineering aptitude. This philosophy was good enough for the days of the Model T, when much of engineering was empirical. But it's no good now. Science has grown too complex, and a talent for taking apart the family washing machine has little or no bearing on a man's capacity for nuclear physics. And anyhow, Russian boys probably do more tinkering than ours. Our great days of tinkering are over. Appliances seldom fail these days, and when they do, replacement and repair services are so efficient that few people bother with their own repairs. If Russian domestic mechanization is less than ours, their opportunities for tinkering are probably greater.

There is another point about technical training that's sometimes overlooked. Every country tends to put its best men into the profession it values the most, or perhaps a better way of putting it is to say that in each country the best men are attracted to the profession on which their country places most value and to which it attaches most prestige. In Germany the best men went into the army; in England, into the colonial service; in America, into business. Now a totalitarian system has the advantage that it can arbitrarily decide which profession shall carry the highest prestige, and right now the Russians are placing great weight upon engineering and science, and giving their young men strong incentives to enter these professions.

What can we do about it? Leaders of industry are becoming increasingly aware of our dangerous shortage of engineers and scientists, and they are spreading this information as fast as they can. Eventually it will trickle down till it reaches boys graduating from high school, where it can be translated into action. But trickling down is too slow. We need direct action now. Every engineer has a duty (if self-preservation can be called a duty) to inform his colleagues so they can influence a wider circle, to explain to the general public so they can influence their children in their choice of a career, and to inform young men so they will realize the urgency of the country's need for their services. Very few boys leaving school are strongly convinced about their careers. For every one who is quite sure what he wants to do there are many who are undecided, and who are influenced in their decisions by the opinions of those whose judgment they value. Many of these young men, who might make outstanding engineers or scientists, will be lost to these professions if they are not helped to appreciate how much the country needs their services.

There is no magic solution to this problem. You cannot create trained physicists and engineers in a few weeks. But now is the time we should be training enough men for the future.

Some figures emphasizing Russian educational advances were given recently by Dr. John T. Rettaliata, President of Illinois Institute of technology. Dr. Rettaliata pointed out that in Russia the college program lasts five and a half years, and in major subjects their education is equivalent to beyond master's degree level here. He also criticized our draft board deferment policies where they prevent students pursuing advanced study. The basis for granting selective service deferments should be the security of the majority. Equality of service is an estimable rule, but like all rules it must be adaptable to circumstances. We want to be fair and not give undeserved privileges, but we also want to survive, and to insist on equality of service at the expense of security is suicidal. There is little merit in applying the principle that all men are equal if a too rigid application of the principle will lead to them all being equally dead.



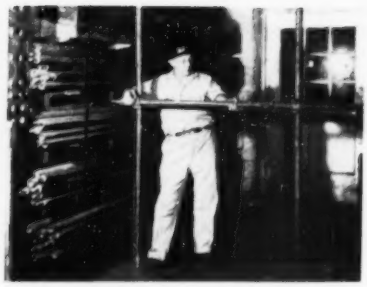


Fig. 2. With tubular scaffolding any platform can be built to do cleaning and painting jobs quickly and safely

Fig. 1. Power plant walls are large and bare and difficult to get at to clean and paint

. . . Power Plant Housekeeping

By J. C. MARSH *

THERE ARE MANY FACETS to the general problem of operating a power plant in the most economical way. Some present such an immediate and obvious challenge that they receive adequate attention at all times. Other types of operating problems tend to fall by the wayside, in the usual rush of events. Such a problem is the matter of housekeeping in the plant. How much money should be spent on an apparently nonproductive task?

The beneficial results of good housekeeping affect both employee relations and public relations. A neat and orderly place to work has a measurable effect on reducing labor turnover among the desirable type of employees and in reducing economic losses from on-the-job injuries. The use of plant tours as a good public relations device is an economical form of advertising but the desired results can not be obtained unless the premises are ready for inspection. The answer to the question of how much expenditure is justified for housekeeping depends on many factors. For a large job, requiring many men, it is possible to apply a number of labor saving and safety devices.

We have found that one of the housekeeping tasks around the plant that is large enough to qualify for special equipment is that of washing the interior surfaces of the turbine room. At Marysville Power Plant, this job involves washing the walls, ceiling, and windows of a room 450 ft long, 75 ft wide, and averaging 62 ft in height. This huge task is the responsibility of the Painting and Building Cleaning Group and is done every four years, with each paint job usually being washed twice during this period. Using the special staging we have developed and applying the necessary safety rules, a detail of 6 men can finish the job in 30 working days.

One team of two men works on a swing stage washing the wall panels, one by one. The condition of the stage is checked regularly, the ropes are inspected, and the men are required to wear safety belts as seen in Fig. 1. This part of the job involves washing the walls up to the heavy beam that carries the turbine room crane. The upper walls and the ceiling are washed by another team of four men working from a special platform mounted on the carriage of the turbine room crane, as shown in Fig. 5. This platform is tilted so as to follow the slope of the ceiling and is supported on telescoping frame. It is possible to raise and lower the platform by 6½ ft, using a chain fall at each corner post. The outer part of the supporting frame is securely fastened to the crane carriage, while the inner, telescoping part of the frame is the support for the platform. The platform itself is made up of 24 twelve in. planks that are 16 ft long. The planks are bolted securely to the frame and heavy canvas is spread over the planking to keep water or paint from

* Technical Engineer, Marysville Power Plant, The Detroit Edison Co.

Fig. 3. Clean and well-lighted locker room as shown above is easier to keep clean than one which is dark and dirty. Tidiness is encouraged by receptacles for garbage, trash, and dirty dishes

Fig. 4. Attaching hose to plant vacuum line for cleaning boiler house floor

spilling onto the operating floor far below.

The supporting frame for the platform has hinged extensions on either side so that the end walls of the turbine room can be reached after the crane has come to the stops at the ends of the crane rails. The upper portions of the turbine room walls above the crane rails can be reached from adjustable staging that is mounted at either end of the supporting frame.

Fig. 6 shows how planks are laid on the adjustable supports so that the wall washers can stand outside the supporting frame.

During the twelve years that this particular staging has been in use, we figure that it has paid for itself twice in saving of man-hours and avoiding accidents on what was a dangerous rigging job.

Another job that is large enough to merit special equipment is the cleaning of boiler-room concrete floors. There is too much dust to permit sweeping and a good solution is the installation of a vacuum system planned with conveniently located outlets.

Fig. 4 shows such an outlet and Fig. 10 shows a building cleaner using a floor cleaning tool. The bottom of this tool, shown in Fig. 11, is made up at the plant, assembled from purchased aluminum swivel heads, and hand made wood and fiber-board plates. These tools are light in weight, rugged, and convenient for operators to use in shift cleanups. Collected coal dust and particles are caught in cyclone separators at suction of vacuum pump and returned to the coal handling system for fuel savings.

An extensive task at power plants is the use of swing stages on outside walls for window washing, sash painting, or re-glazing. The support ropes are usually fastened to hooks over the roof coping stones. To move these hooks, it is necessary to lower the stage to the ground, disconnect the ropes, and then go all the way to the roof and stand on the coping stones to lift weight of hook and hanging ropes. This dangerous task can be eliminated by the use of a device, as

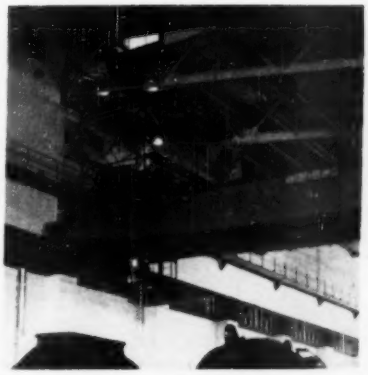


Fig. 5. Platform mounted on plant crane bridge for cleaning and painting walls above level of the crane runway

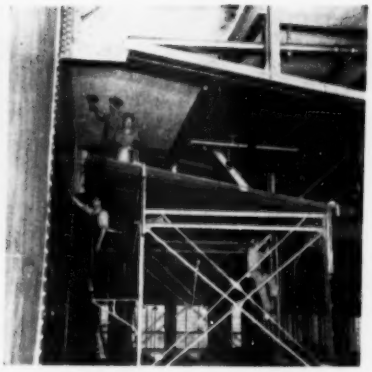


Fig. 6. Close-up of platform in Fig. 5. This arrangement is quicker and safer for cleaning than ladders or rigging

Fig. 7. Common condition of power plant floors. Corners like this seem to attract cigarette ends and other refuse

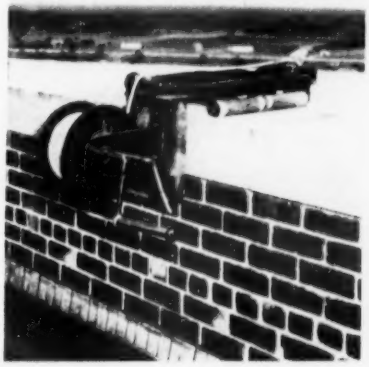


Fig. 8. This support for an outdoor cradle permits it to be moved sideways along a wall without having to be lowered to the ground and raised each time a sideways movement is required

Fig. 9. A coat of white or light colored paint round columns and in corners not only smartens up the whole plant, but discourages spitting and the accumulation of cigarette ends and refuse

Fig. 12. Speed and safety are possible with platform of tubular scaffolding

Fig. 10. Home-made cleaning tool shown in Fig. 11 makes floor cleaning easy

Fig. 11. Cleaning tool of sponge rubber is attached by tube to vacuum system

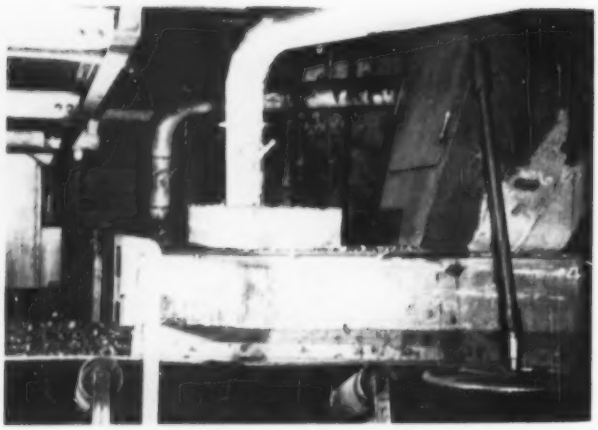


Fig. 13. Where coal discharges on to a conveyor belt, a sheet metal hood prevents dust spreading and helps keep plant clean

. . . . . Power Plant Housekeeping

shown in Fig. 8, which can be used as a movable support. The rollers and roller guides permit the frame to travel readily along the coping stones so that the swing stage can be moved without lowering or necessitating a man's climbing up on the coping stone.

A guiding rule in plant housekeeping is that an ounce of prevention saves a pound of cure. If you control some of the dirt and dust producing features of operation, there is less cleaning to do. If you can prevent accidents by adequate precautions before starting a job, safety records can really be improved.

Using proper scaffolding to reach inaccessible positions instead of the indiscriminate use of extension ladders is a safety factor. For quick erection at a flat wall surface, the Safeway scaffold is used as shown in Fig. 12. For awkward and irregular surfaces, we assemble tubular scaffolding as shown in Fig. 2. This tubular scaffolding is easily stored and is very versatile in the many shapes and heights in which it can be erected.

Another opportunity for keeping ahead of the game is in the scheduling of washing for painted surfaces. This is a continuous process and when walls are permitted to get too dirty to wash, the frequency of painting is increased. We wash with lukewarm "Super-Soilax" solution, applying washing solution with a brush until deposit is softened and then sponging off with rinse water. This process keeps the workers' hands out of strong solution and gloves are not necessary. The more expensive washing powder is economical because less is required and washing is easier.

A lot of work can be saved by cleaning those corner floor areas that provide such convenient targets. They tend to look like Fig. 7. However, if such corners are regularly painted a clean white, as shown in Fig. 9, indiscriminate spitting is discouraged and appearance is greatly improved. Along the line of this prevention work is the care of an area where lunches are eaten. Trash, garbage, and vermin are likely to accumulate, but a really clean and orderly set-up to begin with avoids this development. Fig. 3 shows such a spot on the boiler room operating floor with receptacles provided for garbage, trash, and dirty dishes, and cabinets for storing supplies. This area has stayed neat for over a year.

To reduce dust deposits, a lot of work is saved by controlling it at the source. For instance, we apply dust collecting hoods over the coal conveyors at those points where coal is dropped on to the belts as shown in Fig. 13. The collected dust is withdrawn by fan and separated in a bag filter.

As far as equipment is concerned, very little use is made of rollers except for stippling when decorating offices. Spraying equipment is used on large jobs having many complicated surfaces, but is not used where there is any danger of the paint being deposited on high voltage insulators.

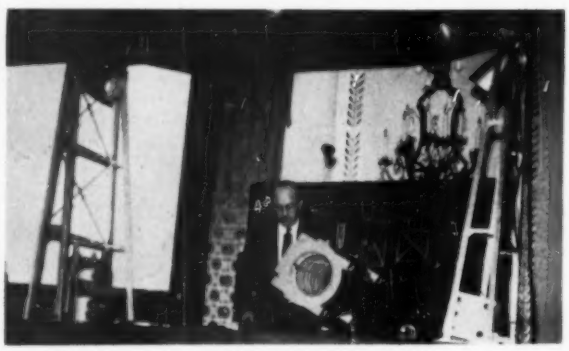
The decision whether to spray or brush often depends on the help and equipment available, and each job has to be decided on its merits. There is no fixed rule.

Working Model Helps Teach Crane Safety

AN EXCELLENT DEVICE for teaching crane safety was demonstrated by Frank Sherman, Material Handling Specialist of General Electric Co.'s Large Steam Turbine and Generator Dept. at the National Safety Congress in Chicago in October. The device is a model crane, as shown in the photograph. With the help of accurately proportioned light wooden models and small slings, Mr. Sherman demonstrated the correct hitches and movements for a number of difficult crane operations.

G-E have been using this model in their crane training school, where it has proved very successful indeed. Apart from its value in helping operators to understand the various lifting techniques, it has raised the morale of all operators to an unusually high level. In this school, crane operators learn their craft thoroughly before going on the job, and as a result they acquire the true confidence that comes from knowing they can handle every problem they meet.

The General Electric model is complete, electrically operated, with push-button controls for hoisting, traveling, and traversing. However, smaller firms, who may not want to spend much money on constructing an elaborate model, can still profit from the idea by making a simpler model. The main thing is to have a method by which operators can be shown how complicated lifts should be rigged and carried, so they will know exactly how to do it before they get out into the shop and have to do the job with full sized equipment.



With light wooden models of all major pieces of equipment used in practice, any shop lifting problem can be simulated in crane operators' training school

Fig. 1. This eroded pipe was quickly repaired without moving pipe or fittings

Photos on this page show what can be done. Without removing pipe, and for only $138 worth of material, 40 ft of this eroded pipe was repaired. Finished job is strong, permanent, trouble-free

Rapid Repairs with Reinforced Resin

REPAIRS WERE SIMPLE, fast, and effective. First, scale was knocked off, and two plies of glass cloth, saturated with polyester resin, were applied over the large holes. Leaks in the bottom part of the pipe were then plugged, and two additional plies of glass cloth, thoroughly saturated with resin, were wrapped around the entire rusted area of the pipe, one at a time.

Only 30 gal of resin were required, and the total material costs amounted to only $138. No piping or fittings had to be removed, and so the high costs of removing and replacing such large pipe were saved.

As Fig. 2 shows, the polyester laminate has enough strength to carry the weight of a man standing over the completely rusted-through sections of the pipe. The laminate will not rust or rot, and its moisture absorption is less than one half of 1 per cent. Experience indicates that long trouble-free service can be expected, but should further leakage occur it can be easily stopped by just applying more laminate to the damaged area.

Oil or gasoline has little or no effect on the resin, and so this method is excellent for repairing eroded and leaking oil pipelines.

If you want to know more about this remarkable method and where the materials can be obtained, write to the Editor or use one of the prepaid postcards elsewhere in this issue. Just write RESIN on the card and mail it to us

Fig. 2. Glass cloth and polyester resin gives quick, strong, and permanent repair

Economic Aspects of Feedwater Conditioning by Evaporation

By A. M. IMPAGLIAZZO*

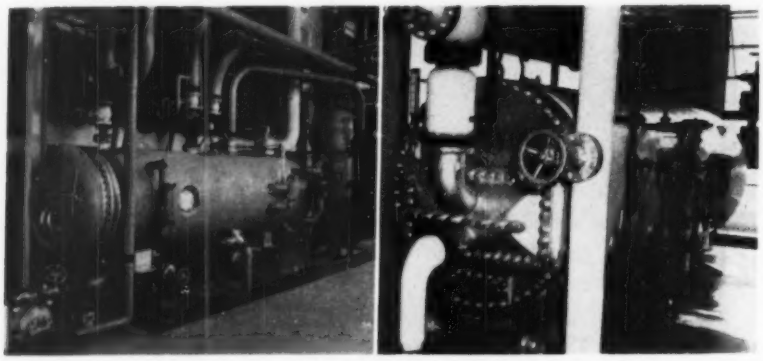


Fig. 1. Two southwestern evaporator installations, capable of 7575 lb per hr at 65 psia (0.1 gr per gal) and 5500 lb per hr at 24 psia (1 ppm), respectively

ALTHOUGH the reliability and efficiency of evaporators for the production of boiler feed makeup are universally acknowledged, too little attention has been drawn to another important characteristic — the favorable economic aspects of evaporator operation.

Few detailed studies of the costs involved have ever been reported. Most studies have dealt only with the relative costs of different evaporator arrangements. But with the recent emergence of deionization processes there has been considerable discussion on the large question of deionization efficiency, and, quite naturally, also considerable interest in the relative costs of evaporation vs. deionization.

Since generalizations regarding comparative costs are of little value, an actual cost comparison will not be attempted in this article. It will be limited to a presentation of quantitative cost data for evaporators and to a discussion of those questions which the user must answer before making economic comparisons in individual cases.

Because evaporators may be associated with the turbine cycle in a number of different ways, it is necessary to determine which is most economical in a given case before a reasonable comparison with other methods of water conditioning can be made. Consider a 60,000-kw turbine operating with throttle conditions of 1450 psig and 1000 F as illustrated in Fig. 2. There are 5 extraction points with the deaerator operating at the pressure of the third extraction point, and there is no evaporator in the cycle.

If a single effect evaporator is to be installed between the second extraction point and the deaerator without a reduction in power output, the heat balance must be modified as shown in Fig. 3. In this arrangement the evaporator vapor is condensed in the main deaerator. Another arrangement which should be investigated is one where the evaporator vapor is condensed in a separate feedwater heater installed in series between the deaerator and the second extraction heater. The drips from the first and second extraction heaters are cascaded through this evaporator condenser to the deaerator. This results in a heat balance as shown in Fig. 4. Multiple effect evaporators (not illustrated) may also be used.

Total annual costs for producing makeup by any method will include a charge for capital recovery and interest, a charge for chemicals and/or fuel, and a charge for care and maintenance. The total additional investment should include in addition to the installed cost of the evaporator or other conditioning unit and its auxiliary equipment, the added cost of housing, of special handling and storage facilities, of modifications it necessitates in other equipment.

Capital Recovery and Interest: Assuming that distillate containing not more than 1 ppm dissolved solids is to be produced from raw feed at 50 F,

* Operating Superintendent, the Griscom-Russell Company

Table of annual costs for evaporating raw water in a typical 60,000-kw plant

Type Evaporating Unit	Fuel	Capital Recovery and Interest			Care and Maintenance	Total
		Evaporator and Accessories	Housing	Increased Boiler Capacity		
Single effect without separate condenser Figure 3	$2240 ($0.443)*	$1755 ($0.35)	$306 ($0.061)	$663 ($0.133)	$1000 ($0.20)	$5964 ($1.19)
Single effect with separate condenser Figure 4	0 (0)	2540 (0.51)	410 (0.082)	0 (0)	1100 (0.22)	4050 (0.81)
Two effect without separate condenser	1230 (0.246)	3160 (0.63)	575 (0.115)	370 (0.074)	1500 (0.30)	6335 (1.37)

* Figures in parentheses represent cost per 1,000 gals of distillate.
The 60,000 kw plant per Figure 2, with no allowance for producing the required make up, is the base from which the above added annual costs have been calculated.

the installed costs of single effect evaporators arranged as in Fig. 3 may be estimated from Eq. No. 1 when the evaporator capacity is between 4000 and 20,000 lb per hr.

$$P = W\left(\frac{27}{\triangle T}\right) + 13000 \qquad \text{(Eq. No. 1)}$$

where P = Installed cost, evaporator, deaerating type preheater, fittings and accessories — dollars
W = Boiler Feed Makeup required — lb per hr
$\triangle T$ = Difference in the saturated steam temperatures corresponding to the pressures of the steam supply to the evaporator, and of the vapor from the evaporator.

For a two effect evaporator plant, approximate costs may be obtained from Eq. No. 1 by using the over-all difference in saturated steam temperatures corresponding to the pressures of the steam supply to the first effect, and of the vapor from the second effect and then multiplying the result by a factor of 1.8.

A similar approximation can be made for an evaporator plant with its own separate condenser, as in Fig. 4, by applying a factor of 1.45 to the results obtained from Eq. No. 1, using the same temperature difference as if the condenser had not been employed. This factor takes into account the cost of the extra evaporator condenser, an added charge for a somewhat larger evaporator, and a credit for the reduction in the size of the extraction feedwater heater at this point.

Space requirements for single effect evaporators and accessories without a separate condenser may be approximated by the formula:

$$S = \frac{W}{2} + 700 \qquad \text{(Eq. No. 2)}$$

where S = Space required — cu ft
W = Boiler feed makeup required — lb per hr

For two effect evaporators, a multiplier of 1.8 should prove adequate, and for single effect evaporators with separate condensers a factor of 1.3 is ample for a well planned installation. Eq. No. 5, like Eq. No. 4, is most useful for evaporators having capacities between 4000 and 20,000 lb per hr.

Costs of such space will be estimated at $1.00 per cu ft. This is a generous allowance for a small increment of space, and the user may well wish to reduce this figure.

Reference to Figs. 2 and 3 indicates that there is a slight increase in steam flow in Fig. 3. This increase in required steam generating capacity will be charged to the evaporator system at the rate of $6.50 per lb per hr. This, too, is quite generous for a small increment of capacity since it is the same figure frequently used for estimating complete boiler house installations. The user should employ

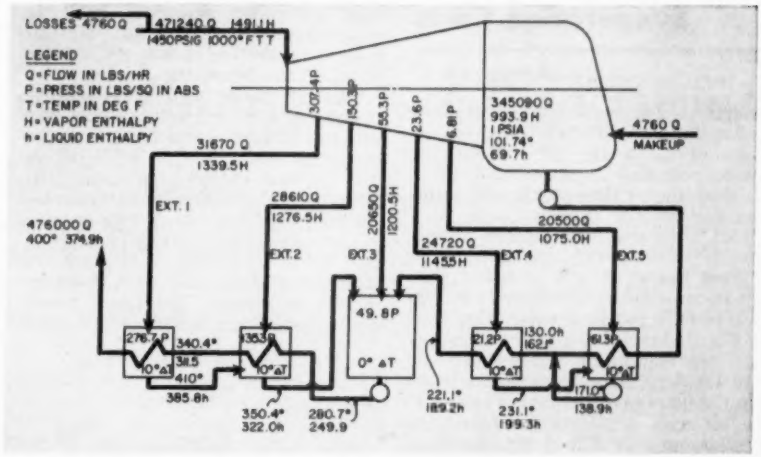


Fig. 2. Heat balance for a 60,000-kw, 1450-psig, 1000 F (turbine throttle) power plant used as basis of comparison for the economic evaluations (see table of costs)

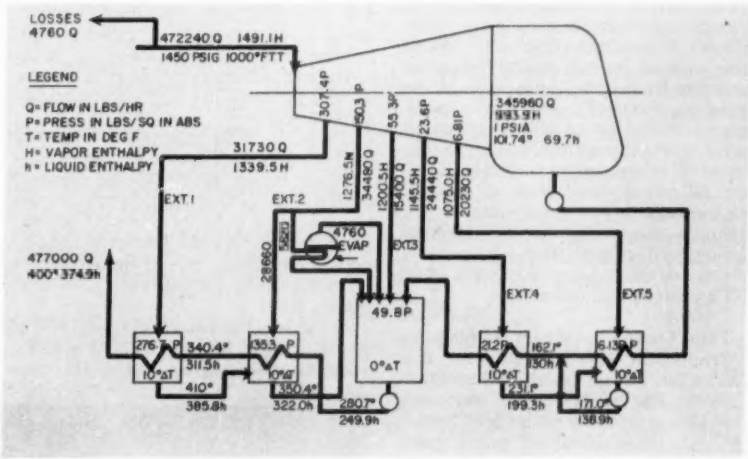


Fig. 3. Same power plant shown in Fig. 1 but with addition of single effect evaporator without separate condenser. Cost annually, $5964, or $1.19 per 1000 gal

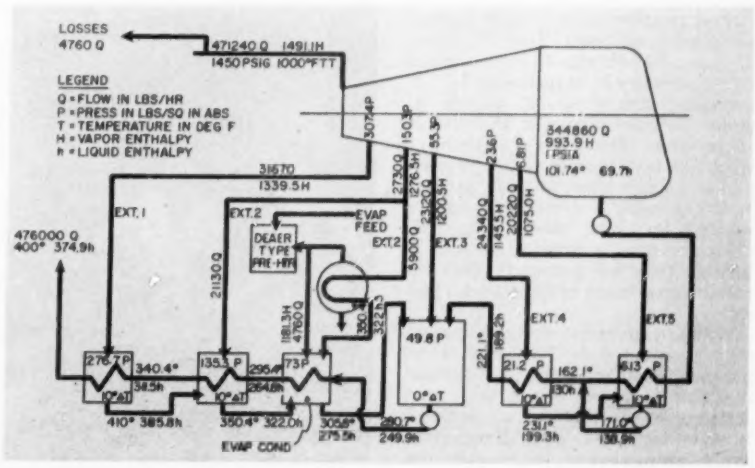


Fig. 4. Same as Fig. 1, but with addition of single effect evaporator with a separate condenser. Total annual costs for purification, $4050, or $0.81 per 1000 gal

. . . Evaporation Costs

continued from page 71

a figure based on his own experience.

Annual costs are calculated on the basis of (1) a 15-year life for the evaporator and its accessories; (2) a 20-year life for the extra housing and steam generator capacity; and (3) a return of 8 per cent on the investment.

Fuel Costs: It will be noted that the steam flow at the throttle in Fig. 3 is 1000 lb per hr greater than that in Fig. 2. Assuming a boiler efficiency of 87 per cent and a fuel cost of $0.20 per 1,000,000 Btu, this results in an annual increased fuel cost of $2345.00 at full load. It will be noted that the arrangement in Fig. 4 results in no increase in throttle flow, and therefore in fuel consumption, over that in Fig. 2. Fuel costs, of course, will vary widely and must be adjusted accordingly.

Care and Maintenance Costs: Cost of care and maintenance is far more difficult to estimate than any of the other costs since it is entirely dependent upon local conditions. It must be based on the user's own past experience or upon that of others operating under similar conditions. In the absence of other, more accurate data, the following estimates of annual costs should prove conservative:

Single effect (Fig. 3)	$1000.00
Single effect with sep. cond. (Fig. 4)	$1100.00
Two effect without sep. cond.	$1500.00

Total Costs: Total annual costs for 3 evaporator arrangements for this particular power plant are summarized in the table. These costs are based on producing boiler feed makeup with total dissolved solids guaranteed not to exceed 1 ppm from raw fresh water, and are relatively unaffected by normal fluctuations in raw water analysis, including silica.

General Comment: Evaporator plants may be designed to meet only normal requirements at their normal operating conditions. Reserve capacity may be obtained with only a slight increase in investment by (1) providing an alternate source of higher pressure steam in the case of single effect units, or (2) piping 2 effect plants so that they can be operated as 2 single effect units in parallel. In either case, fuel economy will be reduced in those rare emergencies when abnormally large quantities of makeup may be necessary, but the initial investment is kept to a minimum.

While evaporation costs are practically unaffected by the raw water analysis, chemical costs in demineralization processes are directly proportional to the dissolved solids which must be removed. Turbidity is relatively unimportant in evaporators, but must be completely eliminated before demineralization is possible.

As usual when comparing two totally dissimilar processes such as evaporation and demineralization true comparative costs are rather difficult to determine because the conditions under which reasonably close equivalence is achieved are not well established. Some factors can be evaluated rather simply while others will depend entirely on individual judgment. For example, an evaporator can produce the same high quality vapor regardless of major changes in raw water analysis; it requires no supplies or skills other than those required to operate the basic power plant itself. Such factors can be evaluated only by the individual user in the light of his own experience.

Other factors, such as capital recovery, which depend on life expectancy are relatively easy to evaluate for an evaporator whose service life can be predicted from reliable historical data but may present problems in the case of the newer processes where similar data are not available. Where life expectancies, spare requirements and such are different, the tendency to compare only initial cost with initial cost, and evaporator fuel costs with demineralizer chemical costs can lead to serious error.

Unique Packaged Boiler Burns Gas and Heats Oil

ORIENTAL Refining Co. of Denver, Colorado, has made an unusual application of a railroad car heating boiler. They are using it to heat reduced crude oil as it is drawn off the bottom of the crude fractionating tower.

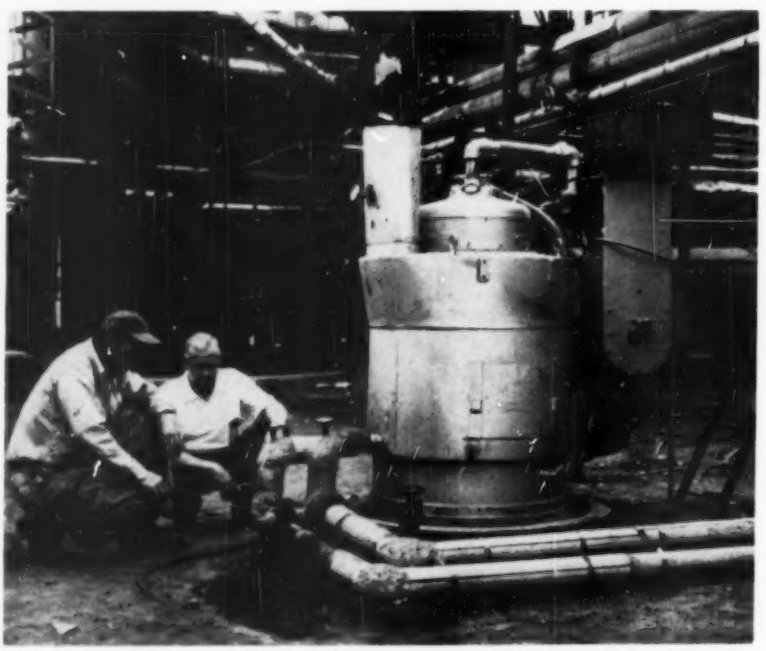
There is little difference between the standard Vapor-Clarkson car-heating boiler and the oil heater, except for the fact that oil is pumped through the coils in place of water. Fuel for the new oil heater is uncondensible gas from one of the refinery's cracking units. This gas has 1500 Btu per cu ft.

Oil enters the heater at about 630 F and is heated to 780 F. At this time, 15 gpm are being heated at the rate of 760,000 Btu per hr. Increasing the size of its pumps will boost flow, and heat transfer will rise to about 1,000,000 Btu per hr — its desired capacity.

Unorthodox though it is, the unit is paying its way even before the new pumps are installed. Capacity of the crude distillation facilities were increased 16 per cent, increasing output from 60 bbl to 70 bbl per hour.

Another unit is in the works now, rated at 3,000,000 Btu per hr, and is expected to find considerable application in the oil industry.

If you wish more information on this ingenious application, write to the editors or jot "Oil Heater" on the prepaid postal card elsewhere in this issue.



Adapted from a railroad car heating unit, this steam generator is now heating crude oil from 630 F to 780 F (150 psig) in its steel coils. Unit is a package

Paint Solvents and Thinners Are Dangerous

Photo copyright by R. S. Johnson

Solvents in a rust-proofing compound started this $250,000,000 industrial fire

Welding sparks falling into a drip-pan of rust-proofing compound caused this fire; but it could have happened just as easily to paint solvents and thinners. Have you taken proper precautions?

By L. G. JONES

HANDLING PAINT THINNERS and solvents requires eternal vigilance, from the time of delivery to the receiving department until its host paint has dried. There is always danger of fire, explosion and poisonous fumes. Certain properties must be known:

1. Flash point, which is the temperature at which vapors arising from the surface of the liquid will ignite. With solvents of low flash points, the presence of a flame, a lighted cigarette, or a spark, may mean a fire.

2. Explosive limit: the range of percentage of the vapors of solvents, mixed with air, which will explode violently when ignited with a match, spark or lamp. Below the minimum percentage limit, the mixture is too diluted with air to be combustible; above the upper percentage limit, the mixture is too rich, with insufficient air to burn. The lower the percentage required, the sooner will explosive conditions be reached in a closed room or chamber. High percentage limit (lower) solvents are safest. In Table 1, the upper explosive limit is omitted because before this percentage is reached, other hazards are generally present, so that safety from explosion because of insufficient air does not make the atmosphere safe at all. The lower percentage limit is the really important one, the one that should be as high as practicable. These percentages are tabulated.

3. Boiling point: the temperature at which its own vapors leave the surface of the liquid freely and rapidly. It is really the "fire" point of the liquid where the entire liquid takes fire, as contrasted to the "flash" point, where some dissolved gases may be lost by the liquid, not its own vapors. Low-boiling point liquids are dangerous when flammable and toxic.

4. Toxic or poisoning effect: the parts of vapor per million parts of atmosphere in the room or chamber, i.e., ppm, that will kill or injure a person or animal. The fewer the parts per million that make a lethal concentration, the more deadly the solvent or thinner. Carbon tetrachloride and carbon monoxide are known killers. They require but 50 ppm to be toxic, fatal to human beings, upon sufficient exposure. Some chemical gases, such as phosgene, Lewisite, and so on, are fatal in lower concentrations than 50 ppm.

It should be borne in mind that low explosive percentages or ppm toxicity, combined with low flash point or boiling point (high volatility), form the most dangerous combinations. Table (1) gives specific values for these properties for the more common solvents and thinners used in the paint industry.

Some generalizations for quick memorizing might be made with regard to safety among solvents and thinners in common industrial use.

1. Group I, linseed oil paint solvents and thinners are less toxic, less flammable, and fairly explosive.

2. Group II lacquer paint solvents are fairly toxic, more flammable and less explosive.

3. Group III synthetic paint solvents are most toxic, fairly flammable and very explosive.

The proper attitude toward all solvents and thinners is to consider them ALL toxic, flammable and explosive. Have plenty of ventilation around the job; avoid smoking, sparks from tools, electrical equipment, etc., or flames in their vicinity. Keep them 50 ft away. Practically all their vapors are heavier than air, so be doubly cautious in manholes, pits, boilers, tanks, or low places. Ventilate pockets well. Use compressed air masks where ventilation is limited.

Table 1. Properties of common solvents and thinners used in paint industry

Solvent Thinner	Flash Point, deg F Closed cup	Boiling Point deg. F	Lower Explosive Limit % volume in air	Toxicity in Air ppm
For oxidizing oil paints, Group I				
Turpentine	95	300	0.8	100
Stoddard Solvent	100–110	300–400	1.1	500
Mineral spirits	100–110	300–400	1.1	1000
Naphtha (safety)	100–110	300–400	1.1	1000
Naphtha V.M. & P.	20–45	212–320	1.2	1000
Hexane-n	–7	156	1.25	500–1000
Gasoline	–50	100–400	1.3	500–1000
For Lacquers, Group II				
Methyl alcohol	54	147	6.0	200
Ethyl alcohol	55	165	4.0	1000
Propyl alcohol	59	207	2.5	200–300
Isopropyl alcohol	53	181	2.5	200–400
Butyl alcohol	84	243	1.7	25–50
Amyl alcohol	109	243	1.2	100–200
Ethyl acetate	24	171	2.18	400
Butyl alcohol	72	260	1.7	200–500
Amyl alcohol	76	300	1.1	200–400
Cellosolve	104	275	2.6	25–500
Cellosolve acetate	124	313	1.7	25–100
For synthetic enamels, Group III				
Acetone	0	134	2.15	500
Cyclohexanone	147	313	–	–
Methyl ethyl ketone	30	176	1.81	250–300
Methyl n-butyl ketone	90	262	1.22	100
Methyl iso-butyl ketone	73	244	1.34	100
Benzol (benzene)	12	176	1.4	100
Toluol (totuene)	100–110	300–400	1.1	200
Xylol (xylene)	63	291	1.0	200
Naphtha, coal tar	100–110	300–400	1.1	200

(1) Data extracted from Amercoal Corrosion Control Reporter, April 1953, and from Handbook of Dangerous Materials, N. I. Sax, Rheinhold Publishing Co.

Help Save the World's First Nuclear Reactors

The world's first nuclear reactor and the first heavy-water moderated reactor are in danger of being destroyed unless means can be found to preserve them for posterity. These historic piles, involving the most significant experiment man ever made, should not be destroyed; they should be made a national monument for all to see

TWELVE YEARS AGO this month an event occurred on the south side of the city of Chicago that was destined to have as far-reaching an effect on our civilization and the course of man's future on earth as anything that had ever happened before. On December 2, 1942, man first initiated a self-sustaining nuclear chain reaction, and controlled it.

Beneath the west stands of Stagg Field at the University of Chicago, late in the afternoon of that now historic day, a small group of scientists witnessed the advent of a new era in science. History was made in what had been a squash-rackets court.

Precisely at 3:25 P.M., Chicago time, scientist George Weil withdrew the cadmium-plated control rod, and by his action man unleashed *and controlled* the atom.

As those who witnessed the experiment became aware of what had happened, smiles spread over their faces and a quiet ripple of applause could be heard. It was a tribute to Enrico Fermi, Nobel Prize winner, to whom, more than any other person, the success of the experiment was due.

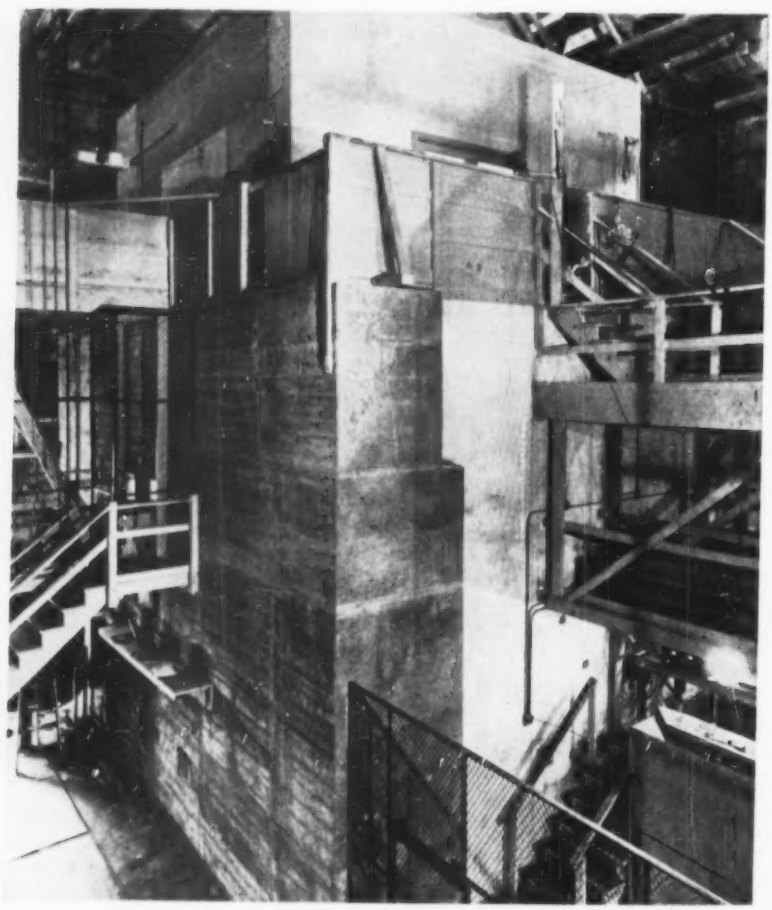


Fig. 1. View of the east (left side) and north faces of the world's first nuclear reactor at Argonne National Laboratory. This reactor was originally constructed at the University of Chicago and operated for the first time on December 2, 1942

Fermi was born in Rome in 1901. He had worked with uranium for years. In 1934 he bombarded uranium with neutrons and produced what appeared to be elements 93 and 94, but the results of the experiment were not clear — it seemed as if nature had gone wild because a number of other elements were present, none of which, however, could be fitted into the periodic table near uranium. It was not until 5 years later that anyone, Fermi included, realized that he had actually caused the fission of uranium, and the unexplained elements belonged back in the middle of the periodic table.

Fermi was awarded the Nobel Prize for his work on transuranic elements in 1938, and that year he and his family went to Sweden to receive the prize. The Italian Fascist press severely criticized him for not wearing a Fascist uniform and failing to give the Fascist salute when he received the award. The Fermis never returned to Italy. From Sweden, having taken most of his personal possessions with him, Fermi proceeded to London, and then to America where he has remained ever since.

Thus, the modern Italian explorer of the unknown was in Chicago that cold December day in 1942. An outsider looking into the squash court would have seen a strange sight. In the center of the 30 by 60 ft room, shrouded on all but one side by a gray balloon cloth envelope, was a pile of black bricks and wooden timbers, square at the bottom and a flattened sphere on top. The top looked like a beehive. During the construction of this crude-appearing but complex pile (this name stuck, though, now, these devices are called reactors) the standing joke among the scientists working on it was: "If people could see what we're doing with a million and a half dollars, they'd think we are crazy. If they knew why we are doing it, they'd be sure we are."

The story of that first atomic pile and the events of that afternoon are now well known. It has been told many times. This experiment was a key part in the world development of atomic energy. Its success was the inspiration for the atomic bomb

project, and today it remains the basis for the world-wide interest in atomic power. Without doubt, it was the most significant experiment man ever made.

On December 2, 1942, the pile was operated to a maximum energy level of only about ½ watt. On December 12 the intensity was run up to 200 watts, but it was not felt safe to go higher because of the danger to personnel in and outside the building. The pile was not shielded.

So, early in 1943 it was dismantled and reconstructed at a site southwest of Chicago in what was known as the Argonne Woods, a property of the Cook County Forest Preserve District. Here the pile was rebuilt, using the same materials and lattice structure as at the West Stands site but at the new site it was effectively shielded by massive concrete walls and provided with automatic controls and more elaborate instrumentation. At the same time a number of laboratory buildings were constructed for an enlarged scientific staff. Thus, the now famous Argonne Laboratory came into being.

Considering that this pile was merely a reconstruction of the first chain-reacting unit ever built, it is amazing that it continued in operation for many years. It had no cooling system and normally it was run at a power level of only a few kilowatts, but occasionally it was operated at high power levels for very brief periods. One of the most valuable uses to which the Argonne pile was put in the early years was in the measurement of neutron-absorption cross sections of a great variety of elements which might be used in piles as structural members or which might be present in pile materials as impurities.

Because there was always the remote chance that the graphite-moderated type of nuclear reactor could not produce the fissionable plutonium required for the program of the Manhattan District project, much thought was given in 1943 to the construction of a heavy-water moderated reactor. During the summer of that year experiments were made proving the feasibility of a heavy-water reactor, and as a consequence construction of such a reactor was started at the Argonne site in September 1943. On May 15, 1944, this heavy-water reactor went into operation at very low power. Thus, it became the world's first heavy-water nuclear pile.

Argonne National Laboratory has grown to huge proportions since those days of 1943, and the Argonne Woods site leased from the Cook County Forest Preserve District has been abandoned for about a year. Today, the old structures housing these two historic piles present a disconsolate, somber picture. It bears little resemblance to the magnificent, new multi-million dollar Argonne National Laboratory a few miles away. Except for a few caretakers and a security guard, this once-thriving beehive of activity is abandoned. The well-kept lawns which once surrounded the buildings are now overgrown with tall grass and rank weeds. The row of hurriedly constructed offices and laboratories are dark and empty.

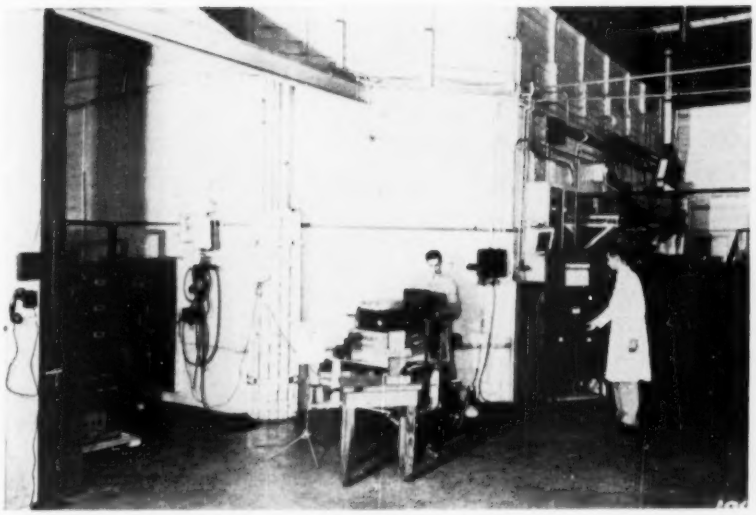


Fig. 2. General View of the first heavy-water moderated pile at Argonne National Laboratory. Construction of this reactor was started in September 1943 at the Argonne site and went into operation at low power on May 15, 1944

Inside the two larger buildings the two piles still stand, inactive and forlorn. The valuable heavy water has long been removed from the heavy water pile, and the uranium fuel elements will soon be removed from both units.

The picture presented here of this historic laboratory is depressing enough but it is overshadowed by even a more distressing aspect concerning its future. As already pointed out, the site in the Argonne Woods was leased from the Cook County Forest Preserve District. The present lease is due to expire in 1956 and the terms of the lease require that at the time of expiration, the site be returned in the same condition it was in when the original contract was drawn up.

This, of course, means that unless some other action is taken, all the buildings including the two atomic piles will have to be torn down and removed.

This, in our opinion, should never transpire. These two piles, particularly, the graphite moderated pile, should be preserved for all posterity. They should stand as monuments to commemorate the greatest scientific achievement man has ever made — the harnessing of the almost infinite power of the atom.

Quite naturally, we were not the only ones to become concerned about this matter. We found that those closest to the project, the scientists and technical personnel at Argonne National Laboratory, had also given the matter considerable thought and that preliminary discussion had taken place concerning methods whereby these historic devices could be preserved and set up as monuments for all the world to see.

Preliminary discussion with the officials of the Cook County Forest Preserve District indicates that they certainly are not averse to having the site made a monument. At the same time, it is quite obvious that this public body does not have funds or authority to finance such a project which would require, first, a large sum for restoring the buildings and improving the grounds, and second, an annual outlay of at least $25,000 for upkeep, maintenance, and supervision.

The Argonne Woods is a beautiful spot. It offers an ideal site for a museum of this kind, and there is little doubt that if steps can be taken to establish it, it would attract visitors from all over the world. Because this was the first nuclear chain reactor ever to operate, its fame will grow through the centuries and to destroy it now would be sheer idiocy. It *must* be preserved, if not by public funds, then by private capital, one way or another.

We make this plea here primarily to direct attention to the need for action, and we invite your discussion comments, and suggestions. We in Chicago, naturally, have local pride in the fact that the first nuclear chain reaction took place here, but the significance of these piles goes far beyond the confines of this city or state, or even these United States. These piles are of world-wide importance. Even our Soviet contemporaries have not claimed the attainment of the first nuclear chain reaction, at least not so far as we know.

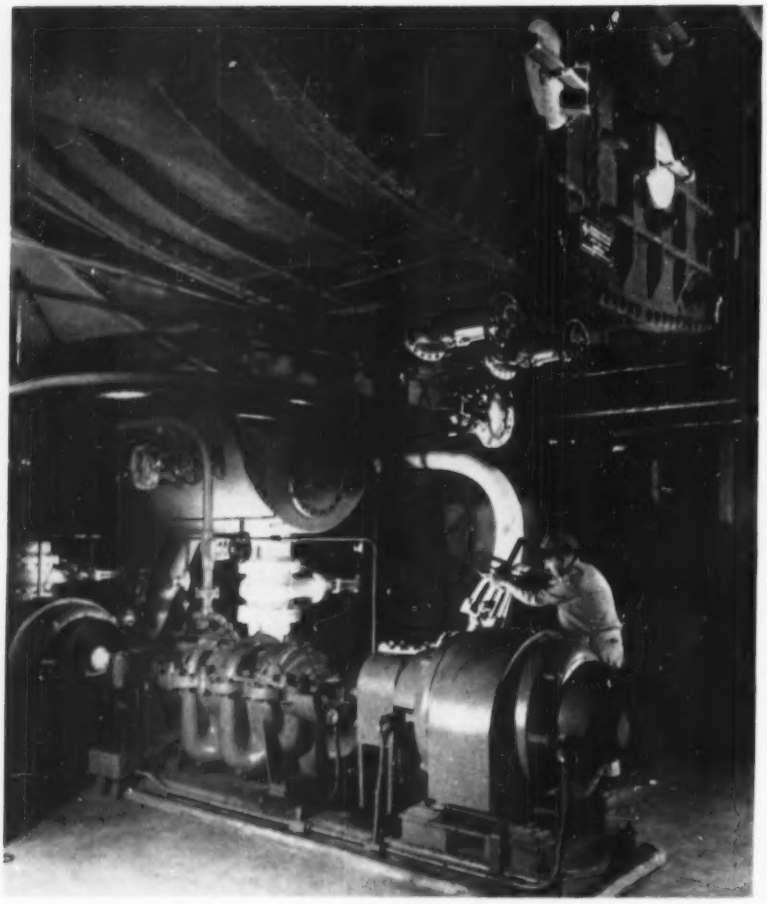


Fig. 1. The condensate pump installation shown in the photograph above serves a large surface condenser in a modern, well-equipped midwestern power plant

Condenser Hotwell Level Control

The control of condensate hotwell liquid levels with constant speed centrifugal pumps poses a number of problems for the designers. The author discusses the reasons for these problems and methods used to overcome them. Here is useful, practical background information

By H. W. FEIST*

ONE OF THE MANY problems confronting the designers of a present-day steam power plant is the selection of a liquid level control for the condenser hotwell which will provide a long and efficient life for the condensate removal pump. As the steam entering a surface type condenser is condensed, it is collected at the bottom of the condenser in the hotwell. In order to insure continuous operation of the power plant, the liquid condensate must be removed from the hotwell as fast as it accumulates.

This is normally accomplished through the use of a constant speed centrifugal condensate pump. Since variations in the turbine loading cause an approximate proportional change in the steam and condensate flow, a pump used for this service must be capable of pumping over wide variations in capacity and head. To enable the pump to carry on this work continually and reliably, it is desirable that some form of pump and condenser hotwell liquid level control be used.

Control of this sort can be applied in one of four basic ways: (1) Submergence Control, (2) Recirculation Control, (3) Control by Throttling the Pump Discharge, and (4) a combination of both the Throttling and Recirculation types of control.

A condensate pump is limited in its capacity by the submergence available. Submergence, often called sealing head, is the static difference in elevation between the condenser hotwell water level and the pump centerline. At its rated capacity and head, a condensate pump is designed to operate at a given submergence. This value must be kept to a minimum since the condenser hotwell is usually just off the basement floor due to the high costs involved in the excavation of a power plant. Consequently, the submergence available is usually very low, about 2 to 3 ft, and only in rare instances will it exceed 5 ft.

Submergence Control

The amount of fluid a pump can discharge is limited by the amount that can enter the pump. In the case of a condensate pump the problem is to provide enough pressure or head to push the water into the pump as fast as it is being discharged. When a pump is used in this type of service, it must remove the condensate from a vacuum where the vapor pressure of the water, for all practical purposes, is the same as the pressure in the condenser. This means that the only force available to push the condensate into the pump is the static head or submergence available. As the liquid enters the pump, this head is reduced by losses due to friction in the suction piping and pump casing entrance as well as the velocity head of the fluid. Therefore, by the time the water reaches the pump impeller, practically all of the available submergence has been lost and the impeller entrance pressure is almost equal to the vapor pressure of the water. The submergence required by the pump is then the head necessary to overcome all these losses plus sufficient pressure to prevent the water from vaporizing at the pump impeller. As the condensate flow decreases the suction passage losses also decrease and the required submergence becomes less.

Figure 2 shows a typical head-capacity curve for a centrifugal condensate pump. Also shown is the system head curve which is the total head which the pump must develop for various flows. It will be noticed that the pump head-capacity curve shows an increase as the capacity is reduced while the system head falls off with a decrease in flow. These opposing conditions cause the pump to reduce the hotwell water level as flow is reduced to where vapor forms in the pump and the pump is said to be operating on its break-off curve.

To illustrate this we will again refer to Fig. 2. With a 3.6-ft submergence, this pump will operate on its normal head capacity curve at point X while delivering 350 gpm against a 200-ft head. The pump will begin to lower

*Blower and Condenser Section, Allis-Chalmers Mfg. Co.

the liquid level in the hotwell as the amount of steam being condensed becomes less because of a reduction in turbine load. This is due to the fact that the pump continues to deliver as much as it can until a point is reached where the amount it is discharging is limited by the amount it can take in. It will then be operating along the system head curve at less submergence such as point Y. Here the pump will have reduced the submergence to 2.8 ft and while operating on its break-off curve will deliver 250 gpm. Similarly, if the turbine load continues to drop the pump will again level off at a capacity such as point Z where it would deliver 175 gpm with 2.4-ft submergence.

When the pump is operating on its break-off, such as points Y and Z, the head available is not great enough to keep the condensate from vaporizing as it enters the pump. The pump is then required to handle a mixture of vapor and liquid and therefore when measured in terms of condensate alone, the pump head and capacity have been lowered. A change in the system head due to varying turbine load means a change in the submergence which the pump will hold due to its design. Therefore, the proportion of vapor to liquid changes, and the pump capacity and head are balanced automatically with the system requirements. As the mixture of water and vapor moves through the pump, the vapor bubbles collapse suddenly due to increased pressure. When a bubble collapses near the pump impeller or casing wall, the water rushing in to fill the space previously occupied by the bubble gives the wall a heavy blow and causes a crackling noise. This action is known as cavitation.

Cavitation, with its resulting noise and shortened pump life, is therefore the big objection to submergence control. It cannot control the liquid level in the hotwell with any degree of consistency nor can it provide a means of supplying a minimum flow of condensate as a coolant through the air ejector inter- and after-coolers, oil coolers, etc. The latter can be overcome by a manually-operated recirculation system operated at light loads. Although it has its disadvantages, submergence control is still the simplest means of liquid level control and requires less power for a given condition than for any of the other methods.

Recirculation Control

If the liquid level in the condenser hotwell is controlled by recirculating some of the flow from the condensate pump, or by throttling its discharge, or by a combination of the two, some of the objectionable features of submergence control can be eliminated. With a recirculating system, a float chamber is attached to the condenser hotwell. Within this chamber a float actuated by the hotwell condensate level opens or closes a valve as required. This may be accomplished by having the float connected directly to the valve through some type of linkage or by having it regulate either air or hydraulic pressure which then operates the valve and permits it to be placed in a remote location.

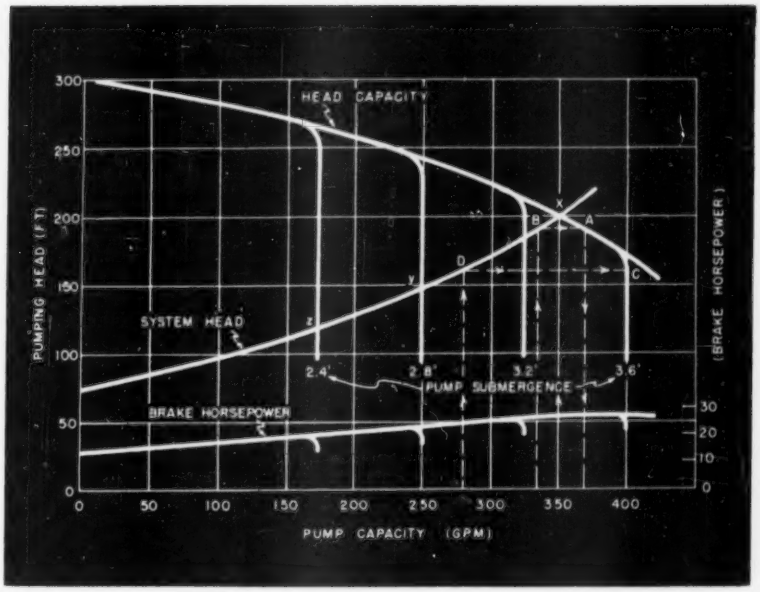


Fig. 2. Graph shows typical performance curves for a centrifugal condensate pump

With a recirculation control system as shown in Fig. 3, a valve, V, is actuated in a recirculation line between the condenser and the pump discharge line — after the air ejector (and any other coolers which may require at least a minimum flow of condensate through them at all times). As the condensate level drops in the hotwell, the valve opens to permit part of the condensate to recirculate back to the hotwell. The valve stays partially open until the condensate returns to the normal level as determined by the controller.

Figure 2 will help to illustrate how a recirculation system controls the operation of a condensate pump. If the float control is set to hold a 3.6-ft submergence on the pump, the pump operating point can move out to a maximum of 400 gpm limited by the submergence being held by the control. Under a 335-gpm load, point B, the pump operates at 190-ft head and 370 gpm, point A. At this condition the pump delivers 335 gpm to the system and 370 − 335 = 35 gpm is recirculated, line A-B. Similarly if the load drops to 280 gpm, point D, the system head is lowered to 160 ft and the pump discharges 400 gpm at 160-ft head at point C. 400 − 280 = 120 gpm is then recirculated to the hotwell as represented by line C-D. As the turbine load continues to decrease the amount of recirculation increases until at no-load the pump is recirculating 400 gpm against 75-ft head, providing the recirculation valve is large enough to pass this amount. The pump operating point and amount of recirculation, therefore, is dependent on the system head corresponding to the load on the turbine.

This method has the chief advantage of always being able to supply the minimum amount of water required by the air ejector coolers and other auxiliaries. It also reduces extreme variations of the hotwell con-

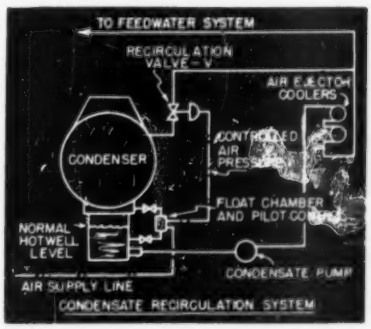


Fig. 3. A schematic diagram showing a condensate recirculation control system

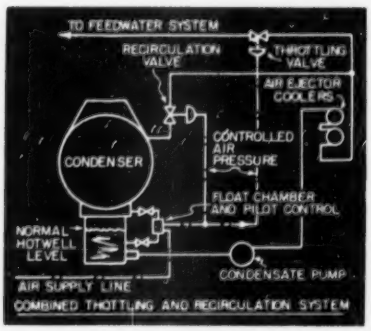


Fig. 4. Control diagram for a combined, or throttling and recirculation system

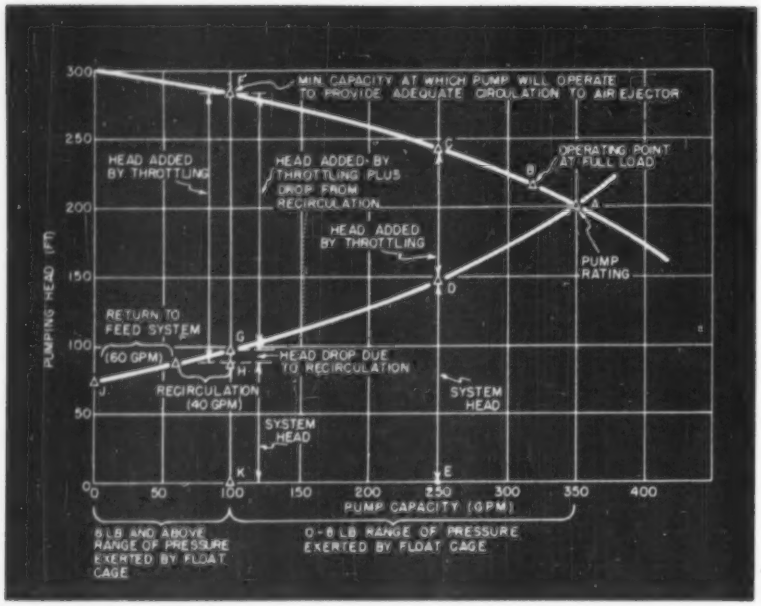

MIN. CAPACITY AT WHICH PUMP WILL OPERATE TO PROVIDE ADEQUATE CIRCULATION TO AIR EJECTOR
HEAD ADDED BY THROTTLING
HEAD ADDED BY THROTTLING PLUS DROP FROM RECIRCULATION
HEAD ADDED BY THROTTLING
OPERATING POINT AT FULL LOAD
PUMP RATING
RETURN TO FEED SYSTEM
(60 GPM)
RECIRCULATION (40 GPM)
HEAD DROP DUE TO RECIRCULATION
SYSTEM HEAD
SYSTEM HEAD
PUMPING HEAD (FT)
PUMP CAPACITY (GPM)
8 LB AND ABOVE RANGE OF PRESSURE EXERTED BY FLOAT CAGE
0-8 LB RANGE OF PRESSURE EXERTED BY FLOAT CAGE

Fig. 5. Performance curves show pump characteristics with combined type control

densate level and reduces pump cavitation problems to some extent. Since the pump generally operates beyond its design capacity, it will operate on break-off much of the time and some cavitation is still likely to occur.

In a power plant designed for the most efficient operation, objections to this system would be raised because the recirculation of water requires additional power to be supplied to the pump motor. In addition, the heat taken up by the condensate as it passes through the air ejector, oil coolers, etc., is lost to the condenser circulating water as the condensate is recirculated to the condenser hotwell.

Throttling Control

Throttle control is simply a method of controlling hotwell liquid level by means of a valve in the condensate discharge line. A float chamber on the hotwell controls the valve opening in the same way that it would for a recirculation system. As the level in the hotwell lowers due to a reduced turbine load, the valve begins to close, thereby throttling the pump to a flow equal to the amount of steam being condensed. This returns the level to its normal position. The level then remains practically constant and the pump operates on its normal head capacity curve.

Since the pump is operating on its true head capacity curve, any cavitation of the pump is usually eliminated. In addition, the power required is usually less than that for a recirculation system.

This system works out well in a plant that normally carries a base load. In such cases in order to supply minimum requirements of cooling water for auxiliaries, it is necessary to recirculate only during start up and when an occasional light load is being carried. This is easily accomplished with a manually-operated valve in the recirculation line. In a plant where the load varies widely and continually, a manually-operated recirculation system is not desirable.

In order to make the fullest use of the advantages of both recirculation and throttling control, many of the present-day steam power plants use a combined system.

Combined Control

A combined recirculation and throttling type of liquid level control is basically a throttling control. The discharge of the pump is simply throttled automatically as the turbine load decreases from a maximum to a point where the air ejector is receiving only the minimum required flow for cooling. A valve in the recirculation line then begins to open as turbine load continues to drop, the throttling valve still closing until there is no condensing load, at which time the throttle valve is fully closed and the entire pump discharge is recirculated. At this condition, the pump discharge is regulated by the amount of condensate that can pass the recirculation valve when it is wide open. The valve is usually selected so that it will pass only the amount required for cooling the air ejector and other auxiliaries.

One type of such control is shown schematically in Fig. 4. With this type, the control at the float cage attached to the side of the condenser is supplied with motivating air at a pressure of around 100 psig. At a maximum condensing or turbine load, the float cage will transmit 3-lb control pressure to the throttling and recirculating valve diaphragms. As reduced condensing load lowers the hotwell water level, the control air pressure is caused to be increased to a maximum of 18 psig at no load.

The throttling valve is a *spring opening* or normally-open type of valve which has its actuating diaphragm set so that the valve starts to close at 3-lb pilot pressure and is fully closed at 18-lb pressure. In other words, this valve is wide open for full condenser load and completely closed at no condensing load.

The recirculation valve is of the *spring closing* type, and its actuating diaphragm is set to start opening the valve at 8 lb and to have it fully open at 18 lb. In other words, the recirculation valve remains closed over the normal operating range, beginning to open only at lighter loads and at a full open position at no condensing load.

Referring to Fig. 5, we find that point A, the intersection of the pump head curve and the system head curve would be the design point of the pump; in this case 350 gpm at 200-ft head. Since the pump is usually selected to have more capacity than needed, it would probably operate at a point such as B under full load conditions. As the condensing load decreases through the 0 to 8-lb range of pressure exerted by the float cage, the throttling valve gradually closes. At a pump capacity of 250 gpm, point D, the system head of 145 ft is increased by 97 ft, the head added by throttling so that the pump is operating on its normal operating curve at point C or 242 ft (145 + 97 = 242).

When the condensing load decreases to a value such as 60 gpm, point I, the recirculation valve opens so that the minimum flow of 100 gpm required by the air ejector is always supplied, point F. Of this amount, 60 gpm is returned to the boiler feed system and the remaining 40 gpm is recirculated. Recirculation then reduces the system head at a flow of 100 gpm to point H or 86 ft. This is a 10-ft reduction in head from point G (96 − 86 = 10). Throttling of the flow to the boiler feed system adds 196 ft of head so that the pump operates at point F on its head capacity curve at 292 ft (292 − 86 = 196). In this way the pump performs on its normal head capacity curve throughout its entire range of operation.

Which of the four types of liquid level control is best for a particular installation will depend on a number of factors, among which are the size and variation in electrical load carried by the station, the preference of the company personnel, and the money allotted for, and the importance placed on, such control equipment. Many of the small installations operate with submergence or no control, while the larger stations will generally operate with at least some form of throttling control. As the future provides us with larger and more efficient power generating stations, so will it more than likely bring into wider use the combined recirculation and throttling method of condenser hotwell liquid level control.

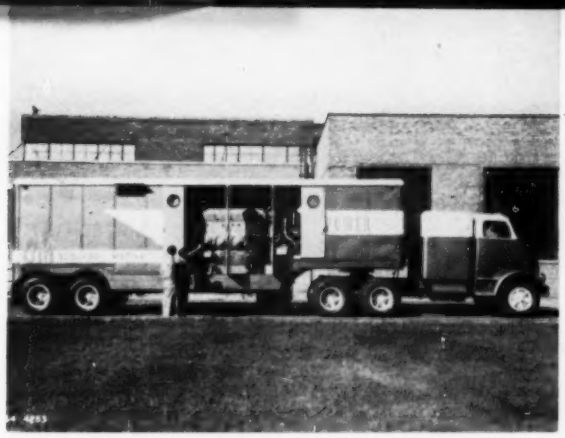


Fig. 1. New 500-kw highway mobile diesel-electric plant

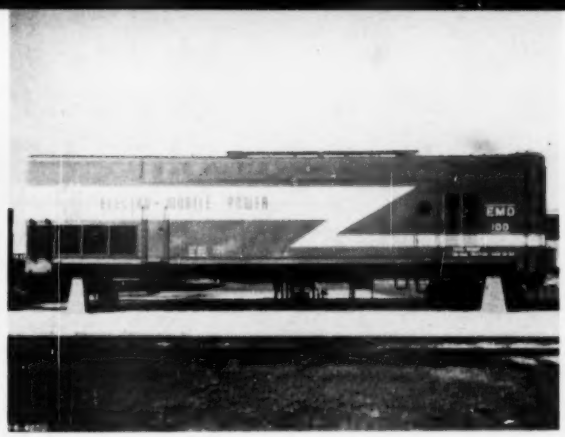
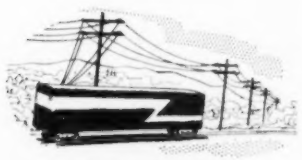
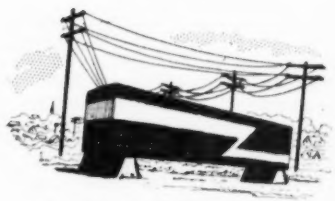


Fig. 2. A 1000-kw mobile plant on a rail car, shown on piers

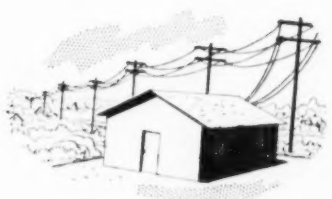
Economy Offered by Mobile Power Units



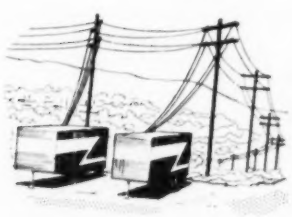
RAIL UNIT ON SIDING



RAIL UNIT ON PIERS



SKID UNIT-TEMPORARY BLD'G



HIGHWAY UNITS PARALLELED

MOBILE POWER for emergency service or fringe area generation was offered to the utility industry recently — and in an attractive economy package. Proud parents of these precision machines are General Motors and its Electro-Motive Division of La Grange, Illinois.

These new mobile (or portable) power units consist of diesel-electric sets mounted on skids, highway trailers or railroad cars, complete with control apparatus. Three units (500, 750, or 1000 kw) are designed for movement over railroads and may be located on any convenient siding near the transmission line to be served. Two units (350 or 500 kw) are designed for movement over highways. Four models of the portable plant, consisting of the same major components as the mobile units, are available in 350, 500, 750, and 1000-kw assemblies mounted on skids for permanent or semi-permanent duty.

Portable or mobile units such as these can be connected singly or in parallel to supply almost any amount of power required by a disaster area or a fringe area which finds itself short of power at times of peak load. Power trains of 100,000 kw capacity could be brought into such an area and dispersed over the required number of sidings. Highway units, of course, have the same flexibility and could be moved in fleets to relieve unpredictable shortages. Automatic synchronizers phase-in each unit as it is added to the line, and a voltage regulator controls excitation to match up generator voltage with the line.

After the unit has been synchronized and brought up to line voltage, the voltage regulator automatically gives proper excitation to maintain a given line voltage (for single units), to share reactive kva equally with other operating units (when paralleled), or to supply a variable reactive kva down to 0.8 power factor as required to maintain a given line voltage.

Provisions have been made to equip the rail and portable models with fully-automatic controls, allowing completely unattended operation. A starting impulse, whether given remotely or by an attendant, initiates the automatic starting sequence as follows: crank and start (2 seconds); accelerate to full speed (3 seconds); automatic synchronization of frequency, phase and voltage, and close the breaker (5 to 20 seconds); generator is loaded to full load (20 seconds). The full starting cycle, plus loading, takes about 45 seconds.

Stopping impulses sent either by a remote operator, an attendant or by special controls, initiates a stopping cycle which involves load reduction to about no-load conditions within 10 seconds, then trips the circuit breaker. The engine is then idled for about 5 minutes, and stopped automatically.

Costs

These power plants are priced at a remarkably low figure — less than $100 per kw in the 1000-kw size. The 500-kw highway mobile unit sells for $63,500, or $127 per kw. It is expected that this low cost, plus a large service organization extending throughout the nation, will interest many utilities in employing the units in fringe areas.

Outlying areas usually have low load requirements which do not justify the construction of new transmission facilities from existing grids. Utilities frequently construct uneconomic lines to tie in these small loads, however, because of their potential load size. Such "protection" lines need not be constructed if mobile or portable plants such as these can be located on the spot.

Engineers seriously interested in these package power plants can obtain more information by writing the editors of POWER ENGINEERING or by contacting the manufacturers direct. Units will be loaned to utilities for try-outs on local problems in the near future. A coast-to-coast tour has been planned to introduce the new units to engineers and utilities executives who wish to see them.

Graphical Boiler Heat Balance

BY PAUL J. GROGAN*

CLASSIC among heat power problems is the execution of a boiler heat balance. The heat balance may be conducted for either of two main purposes: 1, to determine the efficiency and the distribution of heat losses in an existing steam power plant; or, 2, to predict the efficiency of a newly-designed installation for contract purposes prior to the sale, manufacture, and erection of the unit. For either purpose, the heat balance is useful in recognizing the various thermal losses, determining the relative magnitude of each, and pointing to methods whereby they may be minimized.

Heat balances solve for boiler or steam generator efficiency. There are many different kinds of efficiencies and they are defined in many different ways. Also, there are many different kinds of engineers who perform many different tasks. Yet one thing remains common to them all. Engineers are invariably responsible for attaining and maintaining high efficiency, whether it be in the use of machines, materials, money, or men; whether they design, produce, or operate equipment; whether they are new or old to the profession. Good engineering and good efficiency are practically synonymous.

It is impossible to attain a high efficiency through efficiency itself. There is no simple or direct way of advancing the dial of an "efficiency meter." Increased efficiency does not necessarily follow from increased input or increased output. While the engineer's reputation is tied to *efficiency*, he must work and think in terms of *losses*. When he is successful in reducing losses, efficiency improves.

1. Loss Due to Moisture in Air

The idea behind the boiler heat balance is to assume one pound of fuel is fired into the furnace, and then the ultimate distribution of the heat content of that pound of fuel is determined. It is possible to estimate closely or accurately determine the heat units lost to: 1, collected refuse; 2, fly ash; 3, incomplete combustion; 4, sensible and latent heat in water vapor due to combustion air, to moisture in the fuel, and to the release or combustion of hydrogen in the fuel; 5, sensible heat to dry furnace gases; 6, radiation from the setting; 7, soot blowing; and 8, boiler blowdown. The above losses lead to a prediction of the steam generator efficiency in a new design, or they closely confirm the calculated steam generator efficiency in an existing plant undergoing test during actual operation.

Successful combustion of a given fuel in a given furnace at a given rating requires an optimum ratio of pounds of *dry* air per pound of fuel. The word "dry" is emphasized because the actual pounds of dry air supplied per pound of fuel may vary as much as 1 to 2 per cent for a given oxygen content due to the variable presence of water vapor in the air. The table of *grains of moisture per pound of dry air* for varying conditions of dry bulb temperature and relative humidity points up this observation. Remember, there are 7,000 grains in a pound. The condition of 116 grains for 100F air at 40 per cent relative humidity amounts to 1.7 per cent moisture in the air by weight.

Grains of moisture per pound of dry air for varying conditions of dry bulb temperature and the relative humidity

°F	Grains of Moisture for Per Cent Relative Humidity				
	20.0	40.0	60.0	80.0	100.0
20	3.2	6.4	9.6	12.8	16.0
40	7.2	14.4	21.6	28.8	36.0
60	15.6	31.2	46.8	62.4	78.0
80	30.4	60.8	92.0	123.6	156.0
100	57.0	116.0	175.0	238.0	

This table also is used in estimating the moisture content of air for the particular combustion conditions applicable to your problems. Linear interpolation is suitably accurate.

Graphical Construction

Graphical construction (page 81) may be used to determine the magnitude of the energy expended upon superheating the variable water quantity in the combustion air. The necessary data are the carbon content of the fuel, the flue gas analysis, the air and gas temperatures, and the psychrometric data necessary to determine the specific water vapor content of the combustion air.

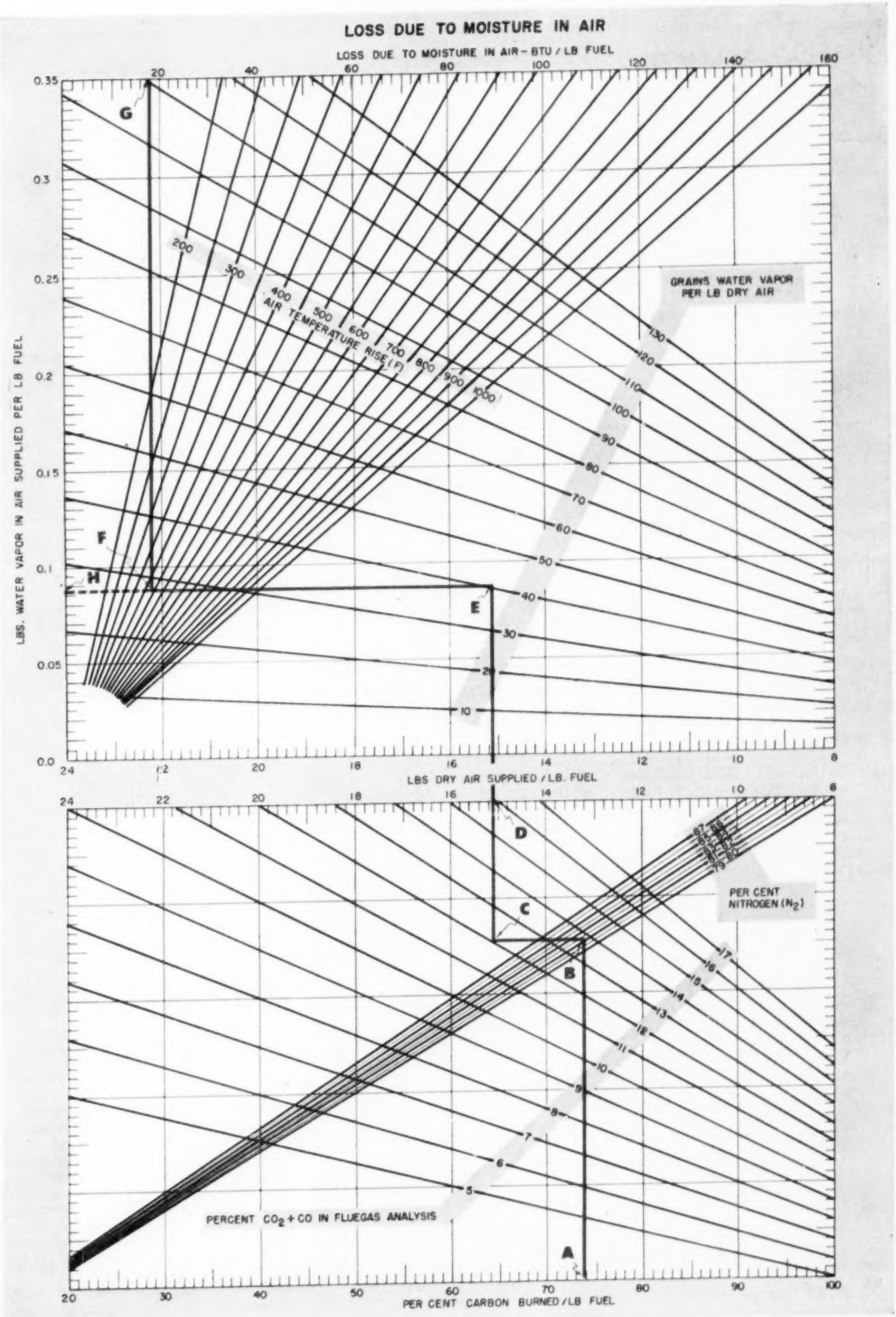
While the effect of this particular loss is small, and may be ignored in many casual heat balances, the construction is interesting in that it also may be used for determining the pounds of *dry air supplied per pound of fuel* in terms of known fuel and flue gas properties. Use of the chart to obtain these values can best be learned by working through the following example.

Our example assumes that 0.74 pounds of carbon are burned per pound of fuel (refer to point A). The nitrogen, N_2, in the dry volumetric flue gas analysis is 81 per cent (refer to point B), while the sum of (CO_2 + CO) is 12.0 per cent (refer to point C). The construction indicates that 15.2 pounds of dry air are supplied per pound of fuel (refer to point D). Assume further that the air and gas temperatures are 50F and 500F, while the incoming air contains 40 grains of moisture per pound as determined by psychrometric data. Point E refers to the 40 grains of moisture per pound of dry air, and point F refers to the 450F temperature difference between the air and gas.

Lastly, we observe the loss due to moisture in the air as being 18 Btu per pound of fuel (at point G). In addition, the *pounds of water vapor supplied in the combustion air per pound of fuel* may be read in passing (at point H) as being 0.085 pounds. This latter term has value in arriving at the over-all moisture content of the flue gases as relates to the induced draft fan loading or to the dewpoint temperature.

The construction is universal and may be applied to any common fuel so long as the "carbon burned" item and the dry volumetric flue gas analysis are known. The reader may wish to verify that if methane, CH_4, containing 75 per cent carbon, is completely consumed with the following gas analysis — CO_2 = 10 per cent, O_2 = 3 per cent, and N_2 = 87 per cent — that the weight of dry air supplied per pound of fuel is 19.9 pounds. Lastly, assume an oil containing 0.86 pounds of carbon per pound of fuel yields a gas analysis as follows — CO_2 = 13 per cent, O_2 = 3 per cent, N_2 = 84 per cent. For these conditions, the weight of dry air supplied per pound of fuel is 17.0 pounds. Both of the above examples approximate conditions of fuel being burned in 15 per cent excess air as evidenced by the 3 per cent O_2 in each gas analysis.

* Chairman, Department of Engineering, and Director, Engineering Institutes, University Extension Division, University of Wisconsin. All republication rights reserved by author.


LOSS DUE TO MOISTURE IN AIR
LOSS DUE TO MOISTURE IN AIR - BTU / LB FUEL
LBS. WATER VAPOR IN AIR SUPPLIED PER LB FUEL
AIR TEMPERATURE RISE (F)
GRAINS WATER VAPOR PER LB DRY AIR
LBS DRY AIR SUPPLIED / LB. FUEL
PER CENT NITROGEN (N_2)
PERCENT CO_2 + CO IN FLUEGAS ANALYSIS
PER CENT CARBON BURNED / LB FUEL
A
B
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D
E
F
G
H

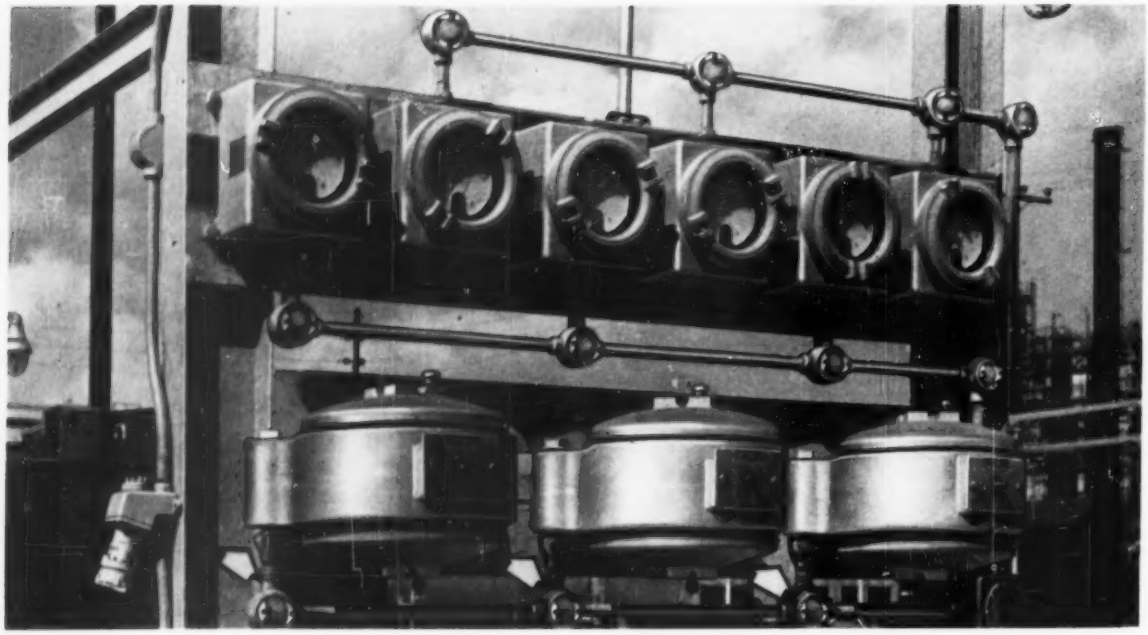


Fig. 1. More explosion-proof equipment showing method of installing sealing plugs to prevent explosions traveling along conduit

Explosion-Proof Equipment

Equipment alone will not protect you from explosions. Unless correctly installed and maintained it will be useless. Here are some points to watch if you want your system to be really safe

By PAUL C. ZIEMKE

IGNORANCE OF ARTICLE 500 of the National Electrical Code, dealing with explosion-proof equipment, can lead quickly to danger and disaster, yet few sections of the Code are less clearly understood. Most people can understand easily enough how a spark will ignite an inflammable gas in an enclosure, and they also realize that if you make the enclosure strong enough it will not be shattered by the explosion; but few appreciate how the explosion is prevented from spreading to the surrounding atmosphere, or the danger of the ignited gas spreading from one electrical system to another. If these things were really understood we would not find so many installations in which large groups of expensive explosion-proof equipment have been rendered useless through neglect of some simple item. To mention just a few: — explosion-proof covers are not completely tightened down; or they are completely tightened, but have one or more bolts missing.

Fig. 2. Explosion-proof starters. Arrows point to seals which would prevent explosions traveling along the conduit to other parts of the electrical system

A gasket, or some kind of sealing compound, is used to seal the joint between cover and box. Conduit is installed between one system and another without sealing between them. Any one of these faults is enough to render the system hazardous and liable to a disastrous explosion at any time.

To quote an actual example. An explosion occurred in the control room of a refinery because the stud bolts holding the milled joint cover in place were not properly tightened. To prove this is true such a stud bolt secured box was enclosed in a stout glass chamber filled with a flammable gas-air mixture. When the mixture contained in the metal equipment was ignited, no explosion occurred in the glass chamber because the junction box was well secured by all the stud bolts. When the same test was made with a single bolt loose, the flame jetted from the loosened lid to ignite the gas-air mixture in the glass chamber and ruptured the paper diaphragm.

When similar tests were made with screw cover junction boxes, no flame was transmitted to the gas filled glass

enclosure to ignite the gas, whether the lid was screwed down tightly or loosely with only the required five threads engaged. The explanation is that the pressure ahead of the flame and against the cover tightens the screw threads, sealing the flame in.

The real meaning of *explosion-proof* was explained in some detail on p. 69 of the February 1954 issue of POWER ENGINEERING. Now we will discuss the danger of an explosion traveling along a conduit from one part of the electrical system to another.

When an exploding gas travels through an electrical conduit or some other confining space, it builds up terrific pressures ahead of it, and with the increase of distance there is a corresponding increase of pressure.

A flame speed curve can be demonstrated in a vertical glass tube, four feet in length and two inches in diameter. The gas-air mixture enters the top of the tube through a one-quarter inch glass tube. The large tube is filled with a gas-air mixture, which is just above the lower flammability range and is ignited at the open base of the tube. The blue flame travels up the tube very slowly.

Various gas-air mixtures are introduced into the tube and ignited. The speed of the flame increases, and the noise of each explosion becomes louder until the gas-air ratio is approximately midway between the lower and upper flammable gas-air mixtures. It is observed that the flame starts slowly, and its speed increases as it travels up the tube. As the flame travels up the tube it acts like the piston of a pump and compresses the gas-air mixture ahead of it. The heavy, sharp explosion occurs when the flame reaches the top of the tube, where maximum compression is present. After the gas in the mixture has been increased above that which gives the highest flame speed and pressure, the color of the flame changes to greenish-blue, and TWO explosions occur; that is one flame follows the other up the tube. There is a proportional decrease in the flame speed as the quantity of gas in the mixture approaches the upper flammable limit. When this limit is reached, the flame will not travel up the tube. Therefore, a gas-air mixture on the rich side of the curve can have the same flame speed as one on the lean side.

All conditions being equal, a flame will propagate upward faster than it will horizontally and will travel horizontally faster than it will downward. If an ignition occurs in a vertical conduit in a hazardous area, the flame will travel faster than it would horizontally or downward in a conduit in the same hazardous area.

Fig. 3. Explosion-proof junction boxes. Arrow points to conduit sealing plugs

By way of proving that conductor filled conduits are not a serious impediment to the passage of flame, five No. 12 insulated wires were pulled into the conduit and junction boxes, and the equipment was charged with a gas-air mixture. When ignited from the outlet end, the flame traveled to the explosion-proof meter box on the opposite end and was visible through the heavy glass lid. When the same equipment was refilled with a flammable mixture and ignited at the meter box the flame traveled toward the junction box end where the rupture disk exploded with violence. These demonstrations proved that conduit filled to Code limited capacity with wires will readily transmit the flame of confined explosions.

Milled or ground-joint and screw-threaded joint covers are the types used on explosion proof electrical equipment. Although both types are approved, the ground joint cover must be handled more carefully and must be kept tight. Defacing these ground joint surfaces by prying them apart with screw drivers or like tools may readily develop a condition where live flame is injected into flammable atmosphere.

The proper sealing of electrical conduits against the flow of gas is vital to the safety of electrical installations in or adjacent to a hazardous area, yet seals are frequently omitted and are commonly neglected requirements of the National Electrical Code. Without properly placed seals an otherwise completely satisfactory explosion-proof installation, erected at great expense, can be reduced in protective value to that of an ordinary installation having absolutely no special protective features.

Celebrations Fete Light's Diamond Jubilee

OCTOBER 26, the 75th Anniversary of Thomas A. Edison's invention of the first practical electric light, saw celebrations of the event in almost every state in the country.

A luncheon to celebrate Light's Diamond Jubilee was held at the Palmer House in Chicago under the sponsorship of the electric industry of that area. More than a thousand persons attended. Gwilym A. Price, president of Westinghouse Electric Corp., made the principal address; Willis Gale, chairman of Commonwealth Edison Co., presided.

One of the features of this luncheon was the recitation by Hazel Jordan of an original poem entitled I Am An Electric Lamp.

Other luncheons and dinners were held across the country from Massachusetts to Oregon. A similar geographical distribution was also shown in the dedication of new power plants for today and tomorrow. At least 12 new plants will be dedicated, from the Veasie, Me. plant of Bangor Hydro-Electric to the Pittsburg, Calif. plant of Pacific Gas & Electric.

Hazel Jordan, age 11, gets admiring glances for recitation from Gwilym Price (left), Westinghouse president, and Willis Gale, Commonwealth Edison chairman

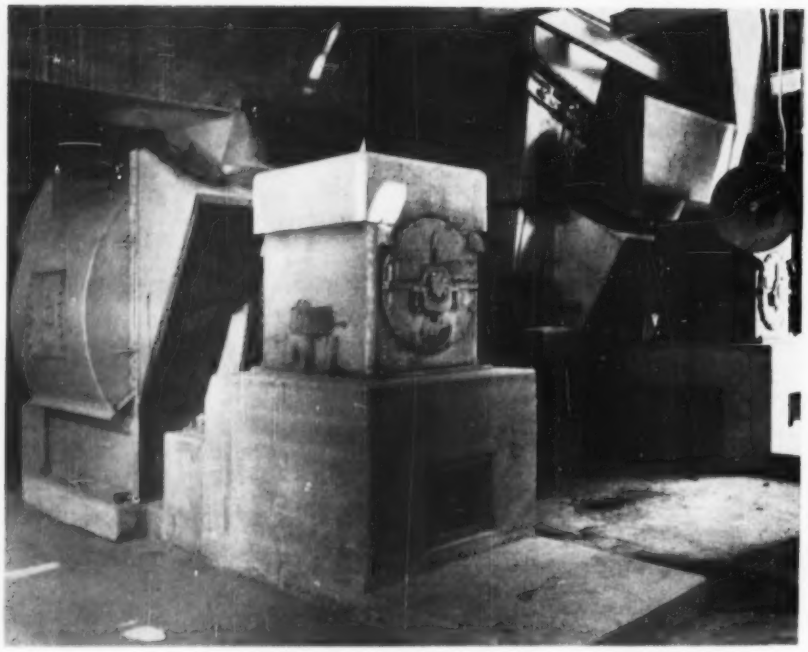


Fig. 1. Outdoor forced draft fans, at a southern plant, fitted with double inlets, rain hoods, radial inlet vanes and outlet dampers

By W. E. WENDOVER *

Fans for Outdoor Plants

In recent years fans for outdoor use have been steadily improved until they are now thoroughly reliable pieces of equipment. Here are main points in which they differ from indoor types

THE PAST decade has seen a tremendous growth in the number of outdoor and semi-outdoor power plants. In the movement to place auxiliary equipment outdoors, it was early found that forced and induced draft fans could be located outdoors without radical or costly changes in design as compared to fans for indoor service.

From the experience gained with outdoor installations during the early postwar period, a fairly set pattern of fan application to this service has evolved. The major consideration in design has been to make the fans suitable for all extremes of weather and outdoor environment. The equipment may have to withstand concurrently one or more of the following clearly defined factors:

1. Ambient temperatures as low as minus 40 F.
2. Ambient temperatures as high as 110 F.
3. Hurricanes and storm-blown debris.
4. Dust and sand storms.
5. Rain, ice, and sleet.
6. Highly corrosive atmospheres, in locations near the ocean.

In designing an outdoor power plant, the engineer must consider mechanical reliability under the above conditions, duct layout for best performance, reduction of moisture in the air for combustion, the possibility of creating a nuisance through fan noise, and location of the equipment from the standpoint of accessibility to operating and maintenance personnel.

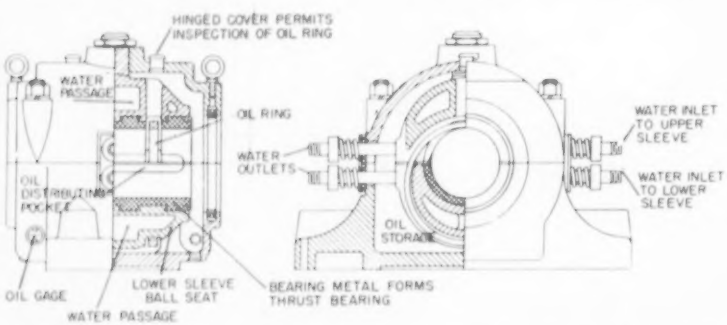


Fig. 2. Typical self-aligning, water-cooled sleeve bearing. For outdoor service bearing is sealed with compound at adjusting screw, studs and horizontal split

Mechanical Reliability

The major new development in fans for outdoor service has been the air-cooling of journal bearings. By omission of water-cooling, the danger of freeze-ups of bearings and of water lines has been eliminated. In general, air-cooling has been fairly successful although the factor of safety of these bearings is considerably less than it would be if water-cooling was used.

Under normal conditions with steady temperatures of gases handled by the fan and of the atmosphere, bearing temperatures steady out at a uniform value. But when a bearing is distressed due to excessive gas or ambient temperatures, or some other unusual condition, the extra cooling capacity which can be provided by water-cooling will permit operation to continue without bearing failure until a convenient time for outage to correct the trouble. In a few cases, air-cooled bearings have failed in such a short time as to cause emergency shut down of the boiler unit, where water-cooled bearings under the same conditions of distress have permitted several hours continued

* Chief Engineer, Green Fuel Economizer Co., Inc.

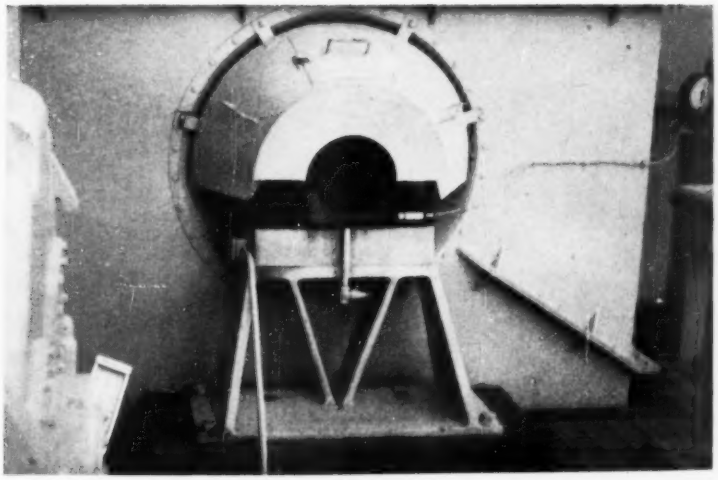


Fig. 3. Rain-shield over bearing of outdoor-type forced draft fan. Bearings on this machine have thermocouples for temperature indication in the control room

operation. In some installations with quite heavily loaded bearings, water-cooling has been added to bearings originally designed for air-cooling, to eliminate the large fluctuations in bearing temperatures corresponding to daily ambient air temperatures.

Recently, a number of designers have successfully specified outdoor fan bearings to be water-cooled even in latitudes as far north as New York State. Provision for draining bearings and water lines during outage periods is made, and sometimes equipment for emergency heating of coolant lines is installed.

Future development of bearing cooling might well follow the design used in automotive work, where an independent closed cooling system is used. Use of the permanent type antifreezes would eliminate freezing dangers, and systems having very large cooling capacity could be provided at low cost. Such a system would also be beneficial for installations in industrial areas where a shortage of service water exists.

Bearing Shielding

To prevent entrance of rain water into the bearings of outdoor fans, most designers feel that it is necessary to provide a cover or shield over the bearings. Such covers do a good job of eliminating rain water from the bearings, but they also make the bearings somewhat less accessible. Many installations have been made without such shielding, and their success depends mainly on good shaft seals plus use of a gasket sealing compound at all joints and closures of the bearings.

Lubrication of outdoor fan bearings must reflect the extremes of weather which will be encountered. In the winter months oil having a low pour point should be used. Also this oil should be resistant to sludging at low temperatures. For summer operation, the oil should be resistant to high-temperature oxidation, and should have a viscosity high enough to prevent oil-film breakdown under the highest ambient air temperatures. The usual tendency is to use too light an oil, with consequent decrease in bearing reliability against "wiping." In localities where dust or sandstorms are common, bearing lubricants should be replaced more often, so that fresh lubricant of good qualities will be available to the bearings.

Grease lubricated ball or roller bearings should use a grease of light consistency in the winter months, to avoid "channeling" of the lubricant and possible starvation of the rotating parts.

Fan Control Reliability

Reliability of the fan control devices is somewhat lessened in outdoor installations due to possibility of atmospheric corrosion, dust, and occasionally to icing conditions. Inlet vane controls are particularly susceptible to trouble from these sources due to the close clearances necessary in their mechanisms, so that author's company prefers the use of inlet louvre dampers with inlet boxes. These inlet louvre dampers result in the same horsepower savings as inlet vanes, at reduced loads, but their mechanism is much simpler, and practically trouble-free.

Forced draft fan reliability is somewhat reduced in outdoor jobs due to the increased necessity for air recirculation as a means of air heater protection. When regenerative-type air heaters are used, and especially on coal-fired installations, the recirculated air often contains a considerable amount of dust. The large amount of recirculated air needed during periods of low ambient air temperatures increases the possibility of dust build-up on the forced draft fan rotors.

In outdoor installations, the plant designer usually finds room to provide the straight, symmetrical ducts at inlet and discharge of the fans, so necessary to obtain proper fan performance. Most engineers have taken full advantage of this, so that few outdoor installations have had difficulty with shortage of fan capacity caused by poor duct design.

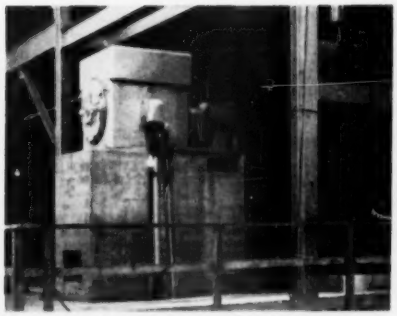


Fig. 4. Outdoor induced draft fans in a Southern generating station. These fans are equipped with rainhoods over inlets to reduce the amount of moisture drawn in with air used for combustion

In many cases, it is possible to utilize quite long evasé sections at fan outlets to provide efficient regain of static pressure with consequent decrease in the size of fan.

Rainhoods on Forced Draft Fans

To partially eliminate rain water from the combustion air entering forced draft fans, it has become common practice to specify rainhoods over the fan inlets. Although design varies from job to job, one type which is quite prevalent is a sloping shed roof extending from the side of the fan outward a few feet. Although no test data with and without such a rainhood is available, from observation of a number of them it is believed that their beneficial effect in eliminating rain water is very small. To provide really efficient elimination of rain water, it would be necessary to make them extend far enough from the fan inlet to cover all of the area where air velocities toward the fan inlet are perceptible. The high first cost of such rainhoods would probably not be justified by the small increase in thermal efficiency resulting from their use.

Along with the trend toward outdoor power plants has come, in the last few years, *continued on page 110*

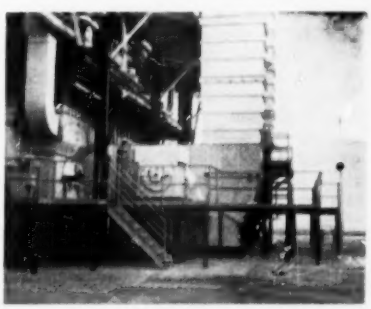


Fig. 5. Forced draft (left) and induced draft (right) fans in outdoor station

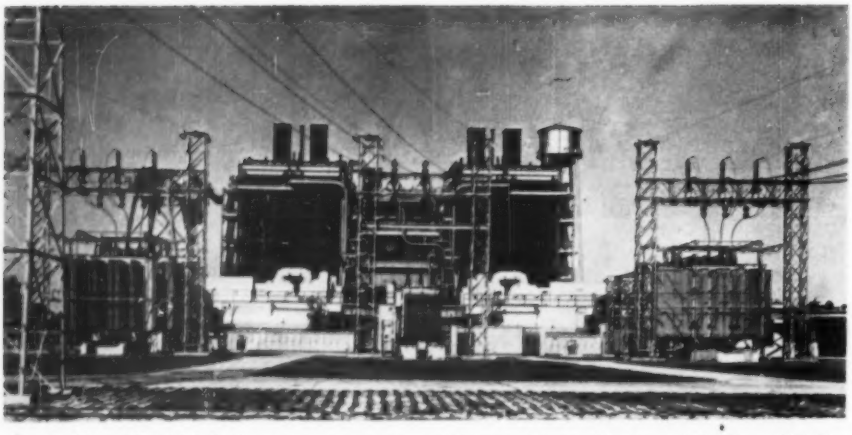


Fig. 1. Two 675,000-lb/hr steam generators at Greens Bayou Station of Houston L&P Co.

Modern Insulated Boiler Settings

By L. D. BRUCE *

DEVELOPMENT OF MODERN, high capacity boiler units operating under mechanical draft has placed added emphasis on correct functioning of the setting enclosure. In fact, the design and construction of the setting directly affect successful performance, safety, and location of the installation. The total area of the boiler setting for some of the larger steam generating units built today exceeds 20,000 sq ft. Every part of this area must be constructed for minimum heat radiation, for complete tightness against air infiltration, or leakage of combustion gas and dust. The setting must be strong enough to resist furnace puffs, minor gas explosions, and the high internal static pressures, both positive and negative, which exist with a large boiler unit in service. Thus it is apparent that great care must be taken in setting design and construction.

Other essential features of the modern, correctly designed setting include: entire independence from pressure parts to permit free movement of drums, tubes and headers and to prevent expansion stresses in these parts or in the setting; efficient heat insulation for low transmission loss and comfortable outside temperature; permanency not less than the life expectancy of boiler units; a structure free from voids and proof against development of voids in service; relatively light weight; reasonable cost; pleasant appearance. The matter of appearance of the equipment is included with necessary engineering features because of the psychological effect on operating personnel. An attractive and well designed piece of power plant equipment is much easier to maintain because those who work around it take pride in its appearance and try to keep it in good condition. This feature can easily pay dividends in reduced operating costs.

Another factor of increasing importance in the design and construction of boiler settings is the growing trend toward the pressurized boiler furnace. When the entire boiler enclosure, from burners to boiler exit, is under air pressure instead of draft, it is essential that the setting be well-insulated and gas-tight.

In modern steam generating units it is customary to select the maximum fan capacity with a liberal margin in both volume and static pressure over and above those actually required for efficient operation at the

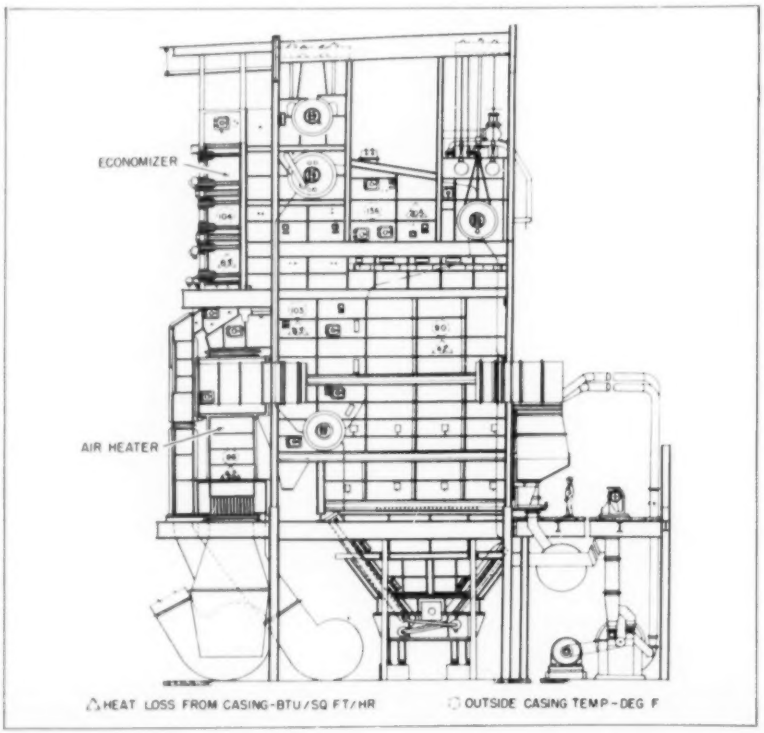


Fig. 2. Insulated casing of modern steam generator. The figures for heat loss and exterior casing temperature are based on 70 F ambient and a 5 mph wind

* Chief Project Engineer, Riley Stoker Corp.

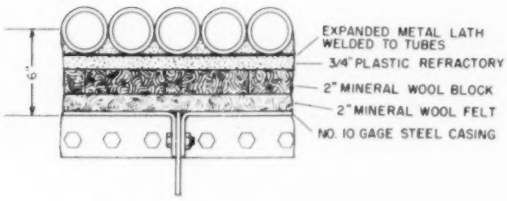

EXPANDED METAL LATH WELDED TO TUBES
3/4" PLASTIC REFRACTORY
2" MINERAL WOOL BLOCK
2" MINERAL WOOL FELT
NO. 10 GAGE STEEL CASING

Fig. 3. Furnace wall section with 3¼-in. tubes showing arrangement of insulation

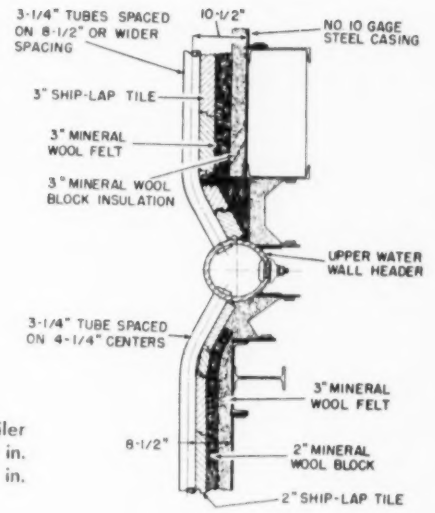

3-1/4" TUBES SPACED ON 8-1/2" OR WIDER SPACING
10-1/2"
NO. 10 GAGE STEEL CASING
3" SHIP-LAP TILE
3" MINERAL WOOL FELT
3" MINERAL WOOL BLOCK INSULATION
UPPER WATER WALL HEADER
3-1/4" TUBE SPACED ON 4-1/4" CENTERS
3" MINERAL WOOL FELT
8-1/2"
2" MINERAL WOOL BLOCK
2" SHIP-LAP TILE

Fig. 4. Detail of header seal for steel-clad insulated boiler casing. Above the header, 3¼-in. tubes are spaced 8½ in. between centers; below, the tubes are spaced at 4¼ in.

maximum steam load for which the unit is designed. Where the setting is of the type with which air leaks must be expected, this margin in fan capacity must be greater than with a permanently tight setting. It is difficult for the designer to calculate setting leakage as it may exist after one or two years of service, and many well-designed installations of steam generating units fall short of predicted design capacity simply because air leakage into the setting is so excessive that the induced draft fan, or its drive, is overloaded before steam output capacity is reached.

High Internal Setting Pressures

A correctly designed setting must fulfill the requirement of withstanding high internal pressures which may momentarily be applied with furnace puffs and minor gas explosions. Strong external reinforcings become necessary especially for pulverized coal, oil, and gas fired units in the larger sizes.

It has not been possible to establish a design standard for the strength of reinforcements which will enable the setting to withstand any possible internal pressure created by an explosion. A steel-encased setting constructed to withstand an internal pressure of 50 lb per sq ft in the furnace and 75 lb per sq ft in gas passages between furnace and induced draft fan, without deflection of external steel members greater than that commonly permissible for steel structures, is generally immune to damage from the more common furnace and gas pass explosions. The most severe setting explosion experienced by our company resulted only in a pronounced bulge of the steel casing and some bowed casing buckstays. From the permanent deformation of the horizontal casing steel members, it was later calculated that the force momentarily exerted on the setting sidewalls by the explosion was approximately 205 lb per sq ft.

Provision for Thermal Expansion

Movement of pressure parts of the steam generating unit must be considered in the design of a steel encased setting as well as with any other type of setting structure. Expansion and contraction movements in tubes, drums and headers are great in the larger capacity units of high pressure. Therefore, the setting enclosure must be entirely free and independent of pressure parts so that no stresses are imposed on either the setting or pressure parts. Where pressure parts penetrate the casing, it is preferable to provide flexible metal seals rather than so-called slip joints. Flexible metal seals will remain tight while slip joints require constant attention.

Setting Material and Supports

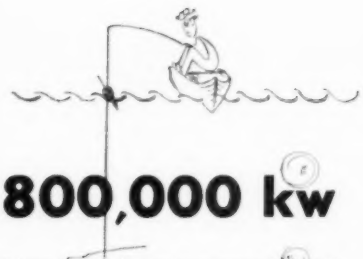
It is often said that a steel casing for a boiler setting hides defects of insulation or refractory materials. This might be the case if materials selected for the setting are unsuitable, or if refractory and insulation are inadequately supported. It is very important to have the setting materials securely anchored to, and supported from, external steel supports.

A steel encased setting generally consists of fire brick tile on the furnace side and insulation between the fire brick tile and the casing. With insulation covering the cold face of the refractory, one of the most troublesome causes of setting failures is eliminated. In thick, solid refractory walls the inner face of the wall may be exposed to temperatures as high as 2200 F, while the outer face is exposed to room temperature. The hot face of the refractory naturally expands more than the cold face; voids will be created between the furnace lining and outer brick shell and channels can develop, through which combustion gases may pass. The quantity of gas passing through these channels may become quite large if the passage connects a gas pass of low negative pressure with one in which high static suction exists, also coal dust or volatile gas may accumulate in these voids and create an explosion hazard. Where the refractory is covered by efficient and permanent mineral wool insulation, the temperature difference between hot face and cold face of the refractory part of the wall is comparatively small and expansion of the refractory remains more uniform throughout the entire thickness of the wall. Although average temperature of the refractory may be higher, the absence of thermal stresses will certainly prolong the life of the refractory.

A wall structure similar to that indicated by Fig. 3 will accomplish the results of air tightness and reliable service. The refractory part of the wall structure should be proportioned so that its cold face temperature is just below the safe temperature limit of the insulation material. The means of anchoring the refractory wall, insulation and steel casing must provide that no separation of these parts will take place in service, and that no crevices will be created between refractory and insulation and between insulation and casing. Most commercial suspended wall designs fulfill this requirement.

This is the first of two articles on the design of modern insulated boiler settings by Mr. Bruce, an expert in his field. The second article on this subject will deal with outdoor installations and details of insulation application.

News Reel

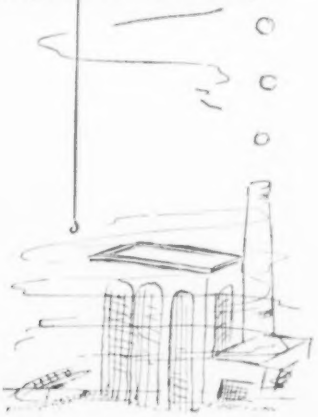


Chicago Flood Knocks Out 800,000 kw

IF YOU WERE reading your newspapers very diligently in early October, you undoubtedly saw mention of the Chicago flood, on October 10. Damage was in the millions; perhaps the most drastic result of the flood was the incapacitation of Commonwealth Edison's Fisk and Crawford Stations. This represented a total of 800,000 kw capacity, the loss of which was felt throughout Chicago.

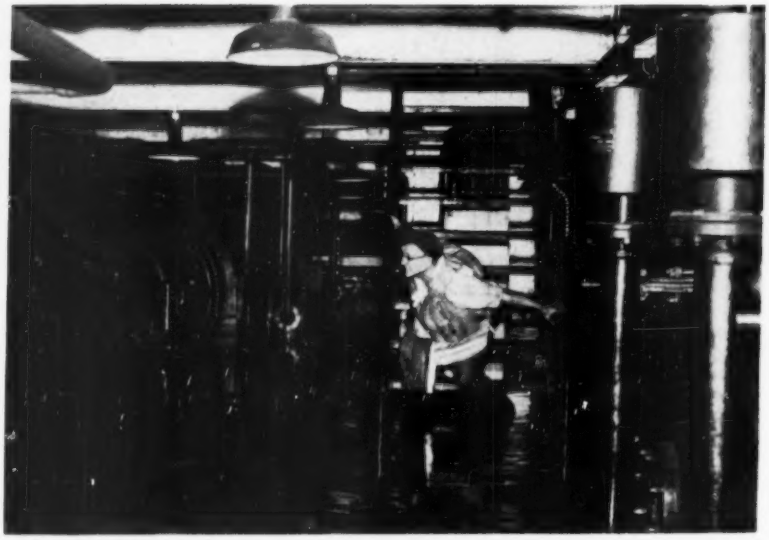
Thousands of workers were laid off as plants closed for lack of power. We in the POWER ENGINEERING offices squinted under reduced lights — those of us who were not home pumping out our basements. But at the Fisk and Crawford Stations, men worked around the clock to restore capacity. Enough capacity was restored by Thursday night so restrictions could be lifted, balance in next 3 days.

EARLY in the flood, it was thought that sandbags could stem the flood. At left, they are palletized for distribution

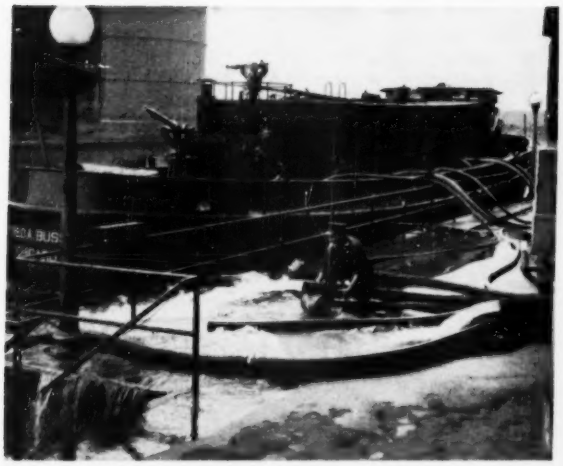


MEN STAYING on the job were served food brought in from the Service Building's cafeteria. Over a million sandwiches were made for the flood fighters (right)

TEMPORARY medical headquarters (above) were set up at Fisk. Special care had to be taken because of the extra danger of infection to cuts incurred in flood

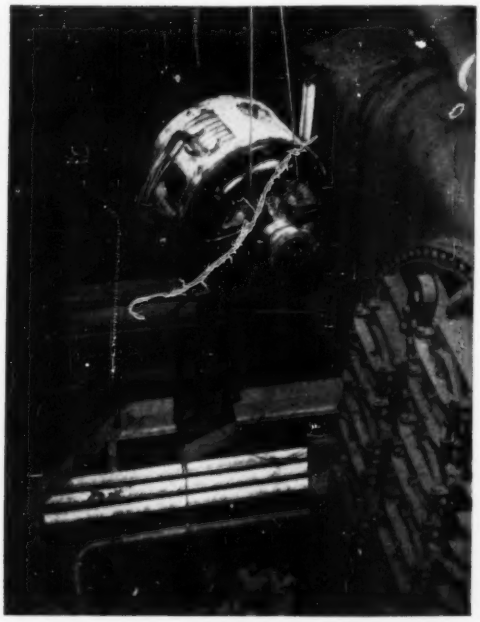


SANDBAGS PROVED inadequate for the record water levels. Fisk and Crawford were shut down when water poured into the stations. Possibly for the first time in history, life jackets were issued to operators of a stationary power plant. Here a turbine operator wears his jacket as he checks pumps and compressors at Fisk

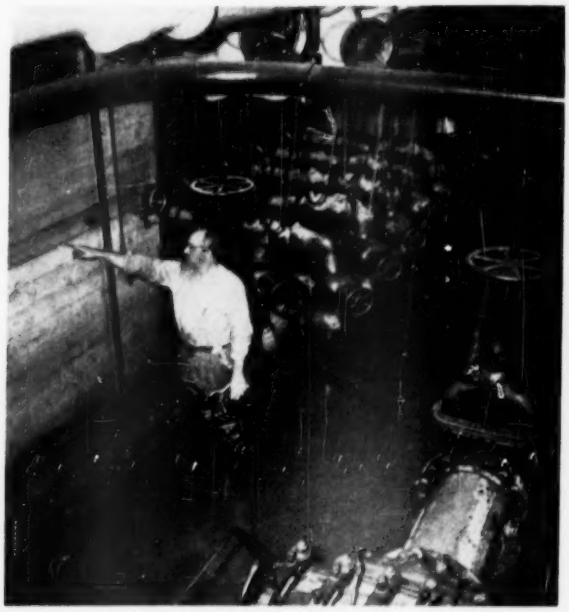


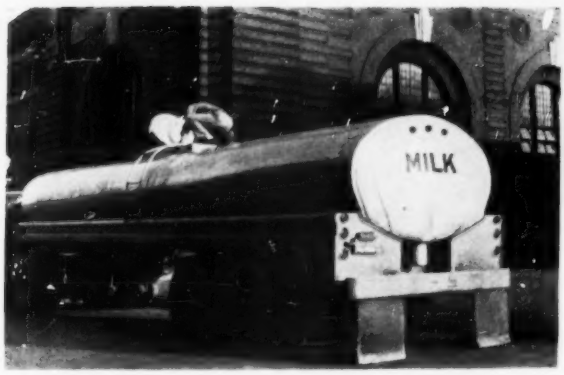
FIREBOAT FRED A. BUSSE of the Chicago Fire Department was tied up alongside Fisk Station to lend its huge pumps to the bailing operation. Reversing the Chicago River, so it would flow into Lake Michigan, gave the pumps much-needed relief

CRAWFORD STATION electrical mechanics were disconnecting bilge pump motors while water was still up to their knees. Life jackets were discarded, but hip boots took their place



CONDENSATE pump motor for Fisk's Unit 17 (left) is hoisted out of the basement for cleaning and drying. The pumps were not damaged; were only cleaned





HIGH WATER MARK (above) at Crawford Station is pointed out by turbine operator. Fish were spotted swimming through the turbine room at Crawford. (Left) Fisk Station obtained clean boiler water from Ridgeland Station by the milk-truck-load

HOW TO PICK

Valves and Fittings for H-T

Steam generation at temperatures exceeding the elastic range of steel is relatively new, but extensive research has come up with enough answers to make practicable the manufacture and use of valves and fittings to operate at or near red heat. Here are some rules

Photo R-P&C Valve Div., American Chain & Cable Co.

Fig. 1. 2500-lb gate valve for 1000 F insulated by 9 layers of sheet aluminum

By **CURTISS D. BASSETT** *

THE DESIGN OF a high-pressure, high-temperature steam piping system for service in the plastic range of steel (over 700 F) requires a good deal of judgment and responsibility on the part of the engineer. By the piping system is meant the whole picture, including pipe, fittings, valves, drains, etc.

If there is one tried and true rule for the selection of valves and fittings for high-temperature, high-pressure steam service in the plastic range of steel, it is that they must be of the same material as the pipe. From the pipe materials available an objective choice may be made through use of the method of Ref. 1. The next step is to select valves and fittings of the same material by consulting Ref. 2.

The specification for suitable ferritic steel castings, for instance, is covered by ASTM-A217[2] in seven different grades, each grade containing low alloy additions to match one of the pipe materials available.

Austenitic steel castings for valve bodies are covered by ASTM-A351[2] in several grades also. Of these, only Grades CF8C and CF10MC are columbium stabilized. Type CF8C matches rather closely the austenitic pipe material Type 347 covered by specification ASTM-A213.

In general, fittings, such as elbows and tees, for service in the plastic range of steel are of the welding-end type, butt welding for pipe sizes 2 in. and over and socket welding for pipe sizes $1\frac{1}{2}$ in. and under. Individual engineers will vary from this practice on a given job; but, in general, this represents sound practice. Ferritic alloy steel welding fittings are covered by specification ASTM-A234[2] in several grades. For the above example from Ref. 1, the fitting specification ASTM-A234, Grade WP 11 matches the pipe material A335-P11. Austenitic steel welding fittings are covered by the piping specification, namely ASTM-A213, or specification ASTM-A182[2] for forged fittings, each having several grades. Material for screwed fittings subject to high temperature would be covered by specification ASTM-A182. For the above example A-182 Grade F11 matches pipe material A335-P11.

Pipe flanges, where used for high temperature service, are also covered for material by specification ASTM-A182[2], a general material specification for alloy steel forgings for pipe flanges, forged fittings, and forged valve bodies. This specification embraces at the present time seven grades of ferritic steels and six grades of austenitic steels for matching the pipe material.

Bolting materials for high temperature service are covered by Specification ASTM-A193[2], again in several grades, both ferritic and austenitic to meet the requirements of the service. Specification ASTM-A194[2], also in several grades, covers carbon and alloy steel nuts for bolts for high-pressure, high-temperature service.

Welding Requirements

Where welding is involved on a piping system designed for service above 700 F, absolutely no variation from the principle of matching material should be made without consulting a competent metallurgist[3]. Field welds on such systems between materials not precisely matched should be absolutely taboo. Where the material of a valve body with welding ends does not precisely match the pipe material, it is sound practice to weld stub ends of the pipe material to the valve ends in the shop where the welding can be completely controlled[4]. The field welds can then be between matching pipe materials. Welding rod material also should match the pipe material[3].

Following selection of the proper valve body, fitting, or flange material, their correct pressure class should be determined. The pressure classes referred to are those as defined by A.S.A. standard B 16 e for flanges and flanged fittings and valves. The Code (Ref. 6) provides Table A-9 for selecting the correct pressure class for a given temperature. This table gives temperature and pressure ratings only for carbon steels and carbon-molybdenum steels for ring joint facings and for facings other than ring joint, four tables in all. The tables are used, as follows:

Select Correct Table

1. For welding-end valves, use the table for ring joint facings.
2. For chrome-molybdenum steels with flange facings other than ring joint, the ratings up to 750 F are the same as for carbon steel[4].
3. For chrome-molybdenum steels with flange facings other than ring joint, the ratings from 750 F to 900 F are the same as for carbon-molybdenum steels[4].
4. For chrome-molybdenum steel valve bodies with welding ends or flanges with ring joints, the ratings up to 800 F are the same as for carbon steel[4].
5. For chrome-molybdenum steel valve bodies or flanges for use at ratings higher than mentioned above see Ref. 8.

Reference 6 in the section on "Fittings" describes further specific requirements for rating valve bodies and flanges.

A very effective technique in erecting a steam piping system for service in the plastic range of steel is to cut long runs short and cold-spring them from two thirds to the full computed expansion instead of the usual half computed expansion[5]. This is especially effective for industrial plants where frequent shut downs occur, such as over week ends. With this technique, stress in valves and fittings and connecting flanges on equipment, due to thermal expansion, is at a minimum at the high temperature of operating service. During shut down when the piping system is cold, stresses due to thermal contrac-

* Engineer, Cummins & Barnard, Inc., Consulting Engineers

tion are, of course, high; however, at these temperatures the piping system is better able to withstand high stresses.

The use of flanges in these steam piping systems usually is held to a minimum. Flanged fittings are out of the picture, their place having been taken by welding fittings. What has already taken place with fittings is now rapidly becoming acceptable practice with valves, i.e. for a number of good reasons welding-end valves are replacing flanged valves for high-pressure, high-temperature steam service.

Fundamentally and theoretically flanged joints are out of place in high temperature piping systems. The use of flanges introduces serious problems of stress due to temperature differences between the rim of a flange and the inside of the pipe[5].

An often heard criticism of welding-end valves from engineers is that the stresses introduced into the valve body from welding destroy the alignment between seat and valve and thus the effectiveness of the valve. Concerning this, Ref. 6 describes acceptable welding-end valve body design and welding procedure for minimizing this danger. Valve manufacturers in general follow the recommendations of Ref. 6. As a further precaution in this matter, it is good practice to weld stub ends of the pipe material to the valve ends in the shop where welding can be completely controlled and the valve body adequately safeguarded[5]. Field welds will then not affect the valve.

Valve Seat Materials

Naturally, in a welding-end valve, permanence is required of the seat materials. Valves can be furnished with a number of seating materials for steam service in the plastic range of steel, usually as hard overlays fusion welded to the seats and disc. Of these the most common materials are Stellite, Hastelloy, and Colmonoy, all extremely resistant to steam corrosion up to 1200 F either as overlays or as solid seating. More modest seating materials, such as ferritic stainless steel with 12 to 14 per cent chromium and austenitic stainless steels[5], are acceptable below 800 F.

Either austenitic or ferritic stainless steels are acceptable as stem materials for this service[5].

While selecting the proper material for the valves and fittings in a piping system operating in the plastic range of steel is important, the detail design of the system also is important as it affects these components. The discussion above concerning flanged joints is illustrative of such problems. Reference 6 just about sets the type of valves and how many of each must be employed between the boiler and the turbine. In general, even in industrial installations with steam temperatures above 700 F the trend is to attach one boiler to one turbine as is common practice in public utility generating stations operating in this same range. This type of set-up satisfies the Code[6] with a minimum of valves in the main steam piping, only the turbine-trip throttle valves being required.

If, however, the boiler outlet leads to a header supplied also by other boilers, as is true of many industrial plants, the valve requirements for the steam piping are quite different[5]; here, a stop check and a gate valve with free-blow drain is required between header and superheater outlet. An interesting combination of the above two extremes can occur in that type of industrial plant using quantities of low pressure steam even though one boiler may be attached to only one turbine. Where the turbine operates under back pressure with the exhaust steam and some extraction steam going into the plant low pressure headers, which headers may still be supplied by the old low pressure standby boilers, the new main steam piping must be valved just as if it went from the boiler to a header common to other boilers. This would be true also in the case where a reducing valve connecting from the high pressure main steam pipe supplied a low pressure header common to other boilers, or where an auxiliary turbine supplied from the main steam pipe discharged into such a header.

Such details as low point drains from the main steam pipe can be design trouble-makers. For this type of service many engineers prefer to eliminate steam traps altogether and to employ only valved drains which can be opened before bringing up the steam pressure after a week end shut down, for instance, to allow the piping and the throttle valve to drain. During continuous operation these drains remain closed and the superheat in the steam prevents condensation in the main steam piping. This type of visual drain has been in use for a long time to drain the body and stem of turbine trip throttle valves.

Other engineers, while retaining the open trip throttle valve drains, prefer to use steam traps to drain low points in the main steam piping system. Steam traps employed most successfully for this type of service are of the thermodynamic type.

H-T Piping Limits

Whatever the method employed one question always arises in drain piping, viz., where does the high temperature alloy piping stop and the carbon steel piping begin? In other words if the drain piping contains water at saturated temperature, which in most instances is below 700 F, expensive alloy steel is not required. One certain way to solve this difficulty is to introduce a screwed fitting, such as a tee, into the sediment leg of the low point drain and to make the transition at this fitting. The other way is to assume that since the pipe always operates below 700 F or at least never operates continuously above that temperature, welded joints between unmatched material are not critical. In this case the joint may be made at any convenient spot. Figure 2 shows a typical high-pressure, high-temperature system with an old medium pressure boiler as standby.

Another little headache, despite the discussion above, discouraging flanges in general for this service, involves the use of flanges for the steam flow *continued on page 102*

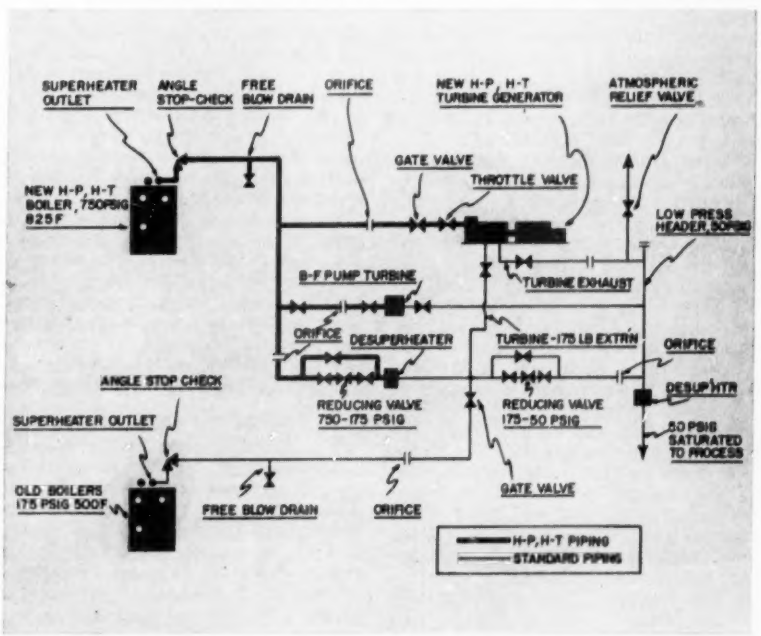


Fig. 2. Schematic diagram shows typical valving and piping arrangement of new high-temperature boiler and turbine with old medium-pressure boiler as standby

What the Wigglers Can Do for the Power Engineer

A group of control specialists, called wigglers, are busy solving complex equipment performance problems with an unusual technique that begins with oscillating, or wiggling, the input controls. Here, in simple language, a top wiggler tells how

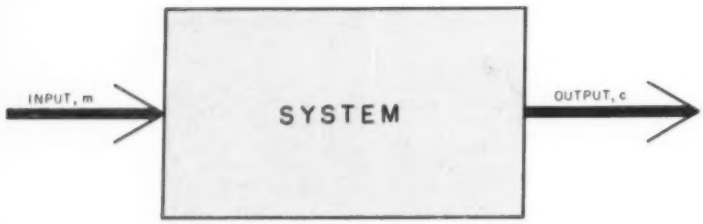


Fig. 1. A block diagram of a physical system with *m* as input and *c*, output

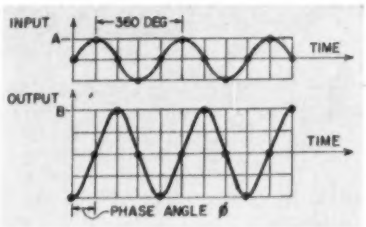


Fig. 2. Curves show how a sinusoidal input may result in differing output

By DR. RUFUS OLDENBURGER *

ALL OVER THE WORLD scientists and engineers are busy oscillating equipment to obtain curves that characterize the dynamic performance of the equipment. By the "dynamic" performance of equipment is generally meant its behavior at each instant when the equipment is subject to changing influences. This is in contrast to steady state phenomena. The response of an airplane when the pilot pushes the throttle, and the buffeting of the airplane due to gusts are examples of dynamic situations. In fact, wherever there is change, one has "dynamics."

Scientific engineering design of a piece of equipment involves predicting how the equipment will work when built. Until the advent of frequency response this generally meant writing the differential equations for the equipment. Only well-trained experts were in a position to do this, which meant that much engineering design was based on experience and cut-and-try experiment. Today this situation has changed. By means of *frequency response curves*, which are equivalent to, and derived from, differential equations, a person without advanced mathematical training can often predict, for example, whether or not a controller will work when installed. For the expert, frequency response curves serve as a check on his differential equations.

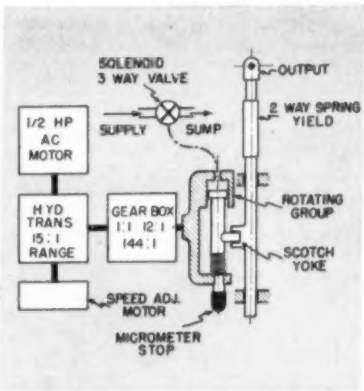
The frequency response approach as understood today originated with a paper in 1932 by Dr. Harry Nyquist of the Bell Telephone Laboratories. He showed that the stability of a feedback circuit could be determined in a simple way from frequency response curves. Both the Bell Laboratories and the radar group at the Massachusetts Institute of Technology applied Nyquist's approach to servomechanism and regulator problems during World War II.

Although a person with little or no mathematical training can use frequency response methods, an understanding of them involves a knowledge of advanced mathematics equivalent to the level of Ph.D., or higher. It is a remarkable achievement of our time that out of an enormous amount of the most profound mathematics, complex variable theory in particular, have come frequency response techniques that can be used by almost anyone to treat control, communication, and other problems scientifically, to design, produce, and service equipment, and to diagnose and correct troubles. The average person who wishes to "wiggle" must accept the results of frequency response theory on faith. That is, he must accept the word of mathematicians that it can be demonstrated mathematically.

Wiggling Explained

To explain what frequency response is about, consider the physical system pictured as the box in Fig. 1. The input *m* is a variable whose values control the values of the output *c*. Thus, *m* can be the throttle position of an automobile and *c* the speed of the car. Or, *m* can be the mass rate of air flow into a vessel and *c*, the pressure in the vessel.

* Director of Research, Woodward Governor Co., Rockford, Ill.



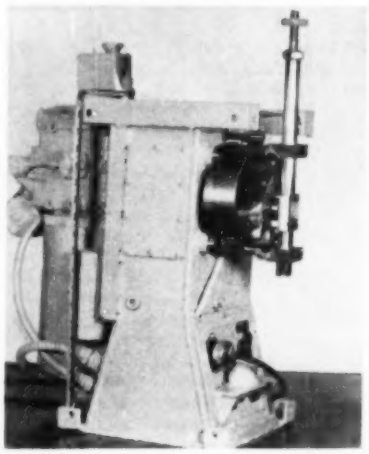


Fig. 3. Device for introducing mechanical oscillation into a control function. Drawing at top shows schematic diagram of equipment pictured in photo

To "wiggle" a system, the input m is oscillated sinusoidally and the output c recorded. Input and output for a particular case are pictured in Fig. 2. Here, the input sine wave has an amplitude A, and the output, an amplitude B. Both input and output waves in Fig. 2 are "sinusoidal" oscillations. The output lags the input by a phase angle ϕ, where ϕ is taken as negative for a lag and positive for a lead. The angle ϕ shown in Fig. 2 is -90 deg, that is, the output lags behind the input by 90 deg. The amplitude frequency response curve for the given system is a plot of the "magnitude ratio", B/A, versus the frequency of the oscillation. Suppose that A is the governing-valve position of a steam turbine, and that B is the turbine rpm measured as deviation from steady state values. Then A might be taken in inches, B in rpm, and time in seconds.

Typical Problem

Figure 4 shows an experimental magnitude ratio curve, marked M, for a steam turbine on full load. Thus, at 0.1 cps the magnitude ratio is 6000 rpm per inch. The experimental *phase curve* for the turbine is marked P.

To obtain the curves of Fig. 4, a mechanical oscillator of the author's company was used (see Fig. 3). The output rod of this oscillator can be made to jiggle sinusoidally at any pre-assigned frequency in the range $\frac{1}{2}$ cycle per minute to 18 cycles per second. The amplitude of the output jiggle can be adjusted to be any value in the range from zero to 1 inch. The oscillator was built for loads on the rod not to exceed 100 pounds. For the runs of Fig. 4, the rod was connected rigidly to the valve plunger of the governing valve of the turbine. This plunger was oscillated over a stroke of ± 0.02 inches for the frequency range of 0.01 to 1 cps. The instantaneous turbine rpm was recorded on an oscillograph, as well as valve travel, so that the phase as well as the amplitude of the oscillations in rpm could be read off directly. The runs were made so that the rpm oscillations were at about the 5000-rpm level. Thus at 0.5 cps the rpm varied sinusoidally between 5000 ± 26 rpm, i.e., between 4974 and 5026 rpm. Dividing 26 by 0.02 yields the magnitude ratio 1300 associated with the point P_1 in Fig. 4 at which the frequency is $\frac{1}{2}$ cps. Similarly at 0.1 cps the turbine speed varied from $5000 - 120$ rpm to $5000 + 120$, yielding the magnitude ratio 6000 associated with the point P_2 in the figure.

From the figure it is clear that the turbine speed lags the valve plunger movement; for example, by 85 deg at 0.1 cps and 120 deg at 0.5 cps.

Experimental frequency response curves of a governor for the steam turbine are plotted in Fig. 5. These curves hold for certain governor adjustments. The ballhead drive was oscillated about a base speed of 1000 rpm. There is a 5:1 reduction in the governor drive so that when the turbine is running at 5000 rpm with the governor installed the governor flyweights will rotate at 1000 rpm. To obtain the curves of Fig. 5 a differential was used. The spider of the differential was directly connected to the output rod of the mechanical oscillator. The spider was oscillated so that the flyball speed varied sinusoidally from 990 to 1010 rpm. This was done at various frequencies over the range from 0.01 to 5 cps.

Adding the frequency response curves for the governor and turbine, we obtain the curves of Figure 6. The curves of this figure tell what happens when the governor output is connected to the turbine valve plunger mechanism, but with the governor separately driven and its ballhead oscillated sinusoidally. The input rpm oscillations might be from 1.60 to 5 cycles per second and from 990 to 1010 rpm as before. The amplitude of the turbine rpm oscillations divided by the amplitude of the ballhead oscillations yields the magnitude ratio of Fig. 6. The magnitude ratio curves of the governor and turbine are added by adding ordinates at each frequency. The ordinates are measured from the horizontal axes for which the magnitude ratio is 1. Thus A and B of Figs. 4 and 5 for 0.01 cycles per second yield (A + B) of Fig. 6. Here the ordinate B is negative, so that (A + B) is actually a difference. Similarly, phase angles are added at each frequency to obtain the phase curve of Fig. 6.

Terminology

Where the magnitude ratio curve crosses the axis marked 1 and -180 deg is called the point of *gain crossover*. For the frequency at gain crossover, the sum of 180 deg and the phase angle (180 deg minus the phase lag) is said to be the *phase margin*. The angle 75 deg in the figure at the frequency 0.1 cps where the magnitude ratio is 1 is called the phase margin. *For good design this margin should be at least 30 deg.* The point in Fig. 6 where the phase angle is -180 deg (phase lag is 180 deg) is the point of *phase crossover*. The reciprocal of the gain margin at the frequency of phase crossover is said to be the *gain margin*. The number 9, obtained by taking the reciprocal of the magnitude ratio at the frequency 0.7 cps where the phase lag is 180 deg, is called the gain margin. *For good design this margin should be at least 2.5.* Since the margin conditions are satisfied, the governor when installed on the turbine, and governing, will be stable, and will perform rather well. Somewhat faster control can be obtained by adjusting the governor to yield smaller gain and phase margins. Many engineers design for a phase margin of 45 deg.

The condition of zero phase and gain margins *continued on page 102*

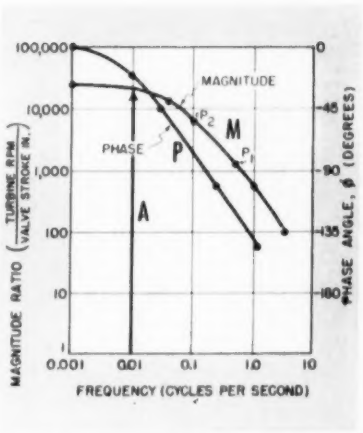


Fig. 4. Experimental frequency response curves for a steam turbine, ungoverned

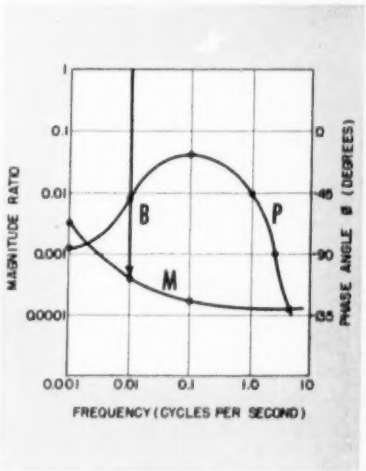


Fig. 5. Experimental frequency response curves for steam turbine governor alone

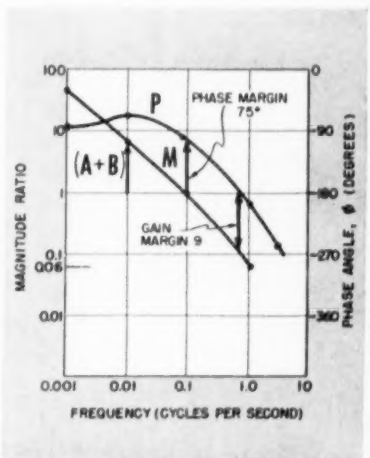


Fig. 6. Frequency response curves for governor connected to a turbine with governor separately driven (open loop)

Power Engineering handbook

A Power Plant Primer

By A. W. KRAMER

INTRODUCTION . . . Some time ago the editors of POWER ENGINEERING were called upon to prepare a non-technical description of a typical power plant to help in the indoctrination of people in the business and production end of our company. Editor Andrew Kramer wrote this description and circulated it in mimeographed form.

Eventually the Power Plant Primer, as it was called, found its way outside the company: Power plant supervisors and manufacturers of power equipment began requesting copies for similar training operations in their own companies. The Primer was printed in an informal booklet to meet these requests.

Since our supply of booklets was exhausted within a few weeks of its printing, the Primer was reprinted — and was promptly depleted a second time. We found that it was being widely used as a text in the training of new plant operators as well as the clerical staffs.

When the POWER ENGINEERING Handbook was initiated in the October issue, it was decided that the Primer should be run serially in Section 1 until the entire booklet had been printed. Since the primary purpose of the Handbook is to facilitate training of plant personnel, it is most appropriate that the Primer be included. Sketches have been left much as they appeared in the original manuscript; the text has also been unaltered except as necessary for production purposes.

We hope that the Primer will prove as useful to you as it was to those who obtained it in its original form.

Part 1

A STEAM power plant is a means for converting the potential chemical energy of fuel into electrical energy. In its simplest form it consists of a boiler and a turbine driving an electric generator.

The boiler is a device for turning water into steam. The steam jet issuing from the spout spins the fan (turbine) and also the generator. In Fig. 1, the very simplest kind of boiler and turbine are shown. The boiler is a tea kettle, and the turbine is nothing more than a little windmill. Actual turbines are more complicated but the general principle is the same.

A word about the generator shown in Fig. 1. To most people the process of generating electricity is very mysterious, yet the actual process is easy to understand. As shown, the generator consists of a little bar magnet spinning inside a stationary coil of wire. This may seem an absurdly simple affair, yet that is exactly what a real generator consists of — a magnet rotating inside of a coil of wire. As the magnetic field issuing from

fold along this line — outside edges toward you

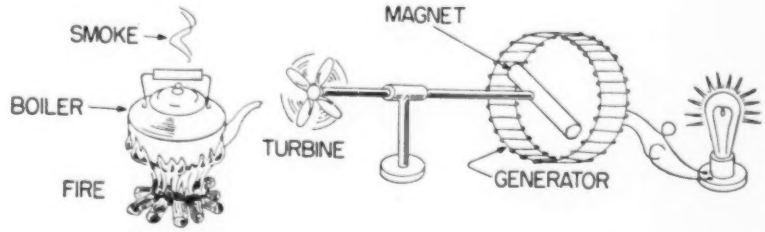


Fig. 1

the ends of the magnet moves across the turns of wire in the stationary coil an electric current is set up in the wire. By winding a large number of turns of wire into a ring or doughnut, the current set up in each turn is added to the current set up in the other turns of wire, and so a much more powerful current is produced.

This is all you need to know about an electric generator now — just think of it as a rapidly rotating magnet inside of a coil of wire; this produces an electric current in the wire. Later we will elaborate on this simple description.

You may wonder, "If a power plant is basically as simple as this, why do we build the complex plants we see described in POWER ENGINEERING?" The answer to this question is quite simple; the plant shown in the sketch is not very efficient, indeed its efficiency is close to zero. Since we want to get as much power as possible out of a given quantity of fuel it is necessary to make our plants as efficient as we possibly can.

Thirty years ago, the electric power plants of the nation used over 3 pounds of good coal to produce a kilowatthour of electricity. Today, the national average is less than 1.1 lb. of coal per kilowatthour. In other words, in 1922 we used three times as much coal to produce a kilowatthour as we use today. In 1953, the electric utilities of this country produced over 326 billion kilowatthours by means of fuel-fired plants. This required the burning of 179,300,000 tons of coal. If, however, we had had to produce this amount of electrical energy by means of the type of plants we had in 1922, we would have needed three times the coal or some 500,000,000 tons.

The reason for this great decrease in the consumption of coal lies in the gradual improvement of our power systems, both with respect to the individual pieces of equipment and in the system as a whole. Just how do we go about improving the system shown in Fig. 1?

Looking at it again, it is obvious that it can be broken down into several divisions. First, there is the fire under the boiler. This involves not only the fuel itself but also the method of placing the fuel under the boiler and the arrangement for burning it properly. So let us extend the diagram to look like Fig. 2.

Here, we see a belt conveyor transporting coal to the furnace where it is

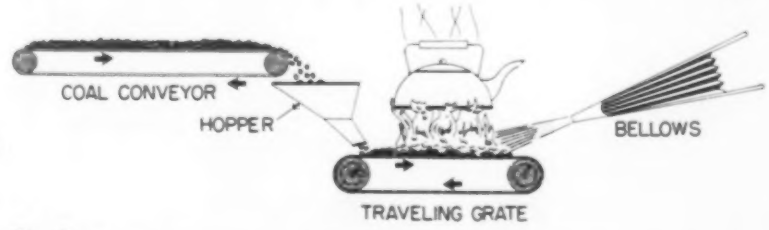


Fig. 2

Now, we have a chimney or stack to remove the gas of combustion and a heater to heat the air from the bellows before it is blown into the furnace. Also, we have put in an ash conveyor.

Now, if you are of an analytical mind, you will see that it takes *additional* heat to heat the air. We have shown a candle. Since candles cost money, it is obvious that we are not going to save much money that way. Why can't we use some of the heat from the fire under the boiler itself to heat the air? Maybe that would be cheaper than buying candles.

Well, it is; and moreover, there is heat going to waste up the stack. You know from experience that if you hold your hand above a tea kettle on a stove that there is a lot of heat being wasted. So, let us put a heating coil in the stack so the bellows will be blowing warm air into the fire as shown in Fig. 4.

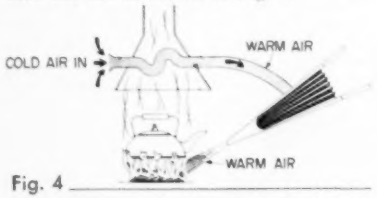


Fig. 4

All this, even to non-engineers, probably seems absurdly simple, and it is. The reason for explaining it in this way, however, is to show, by means of the simplest kind of equipment, how engineers go about improving the efficiency of any system. Step by step, adding something here, saving something there, establishing closer supervision over everything gradually improves the effectiveness and the efficiency of almost any kind of system. These are the kind of things engineers are concerned with. Nearly all of them are more or less complex and require a great deal of specific as well as general knowledge.

In the example just described, for example, just how much surface should the heater in the stack have to heat the air to a certain temperature? How hot should the air be for best combustion, how much air should be supplied, how much power will it take to run the bellows, what happens to the flue gases if too much heat is extracted from the gases, what happens to the stack? None of these are foolish questions.

Consider the last question, for example; that of cooling the flue gases too much. What happens? Well, there is always a certain amount of water vapor in the flue gases; from the air and from the hydrogen in the fuel. As the temperature of the gases is lowered, there comes a time when the saturation point is reached and the moisture condenses. If at the same time there happens to be any sulphur in the gas (and there usually is), sulphuric acid will be formed resulting in the spread of a thin but extremely corrosive layer of liquid on the inside surfaces of the flues.

This single example, then, which is one among hundreds, shows what the engineer runs into when he begins to *refine* the simple system we began with. He may add something to improve it but he may find that the improvement is not an unmixed blessing; it may also have deleterious effects. These, he must guard against.

But, let's get on with our power system. The tea kettle representing the boiler is not a very efficient generator of steam. Let's see if we cannot design a better one. Look at the sketch in Fig. 5. Here we have a boiler consisting of two steel drums connected by a number of steel tubes, and arranged in a furnace so that the hot gases have to pass through the bank of tubes on their way to the stack. The total surface area of the tubes is large, making it possible to absorb a great deal of heat. Steam bubbles formed in the tubes rise to the upper drum (called the steam drum) where the steam collects before it flows into the pipe leading to the turbine.

This is the basic principle of the modern water tube boiler. Note, that a boiler feed pump has been included in the diagram. Since steam flows out of the boiler it obviously becomes necessary to replenish the water that is evaporated. For this reason a boiler feed pump is necessary. This pump must operate at a pressure high enough so that it can overcome the pressure in the boiler.

In the operation of any boiler, even a tea kettle, it is essential always to keep enough water in the boiler. If it should run dry the metal would become red hot, soften, and rupture. At the same time it should not be filled to a point where there is no room for the steam to collect. To check the water level, a water gage is fitted to the steam drum.

fold along this line — outside edges toward you

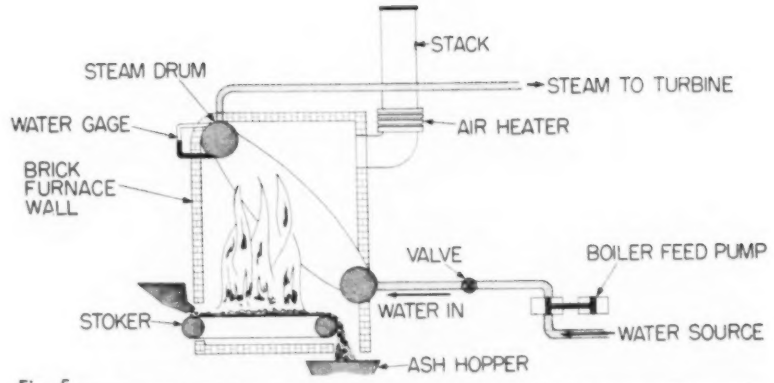


Fig. 5

This shows the water level in the boiler at all times.

Now, it is obvious that if the amount of steam leaving the boiler was always the same as the amount of water entering, the water level would remain the same. This state of affairs seldom transpires. Variations in load causes variations in steam flow; variations in the fuel supply and air supply cause variations in the rate of combustion, which in turn results in variations in the rate of evaporation, and all of these cause changes in the water level. This makes it necessary for the operator to maintain a continual watch on the water level. If it drops, he increases the water supply; if it rises, he decreases it.

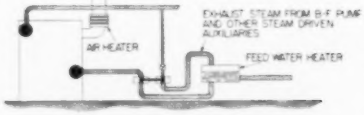
Fig. 6

This constant vigilance on the part of operators was trying, so feedwater regulators were developed which control the flow automatically as the water in the boiler drum rises and falls. These are very helpful even with small boilers but in the case of modern high-pressure boilers they are almost imperative. A large high-pressure boiler, evaporating in the neighborhood of a million pounds of water per hour, would run dry in about 90 seconds if the water supply was suddenly cut off.

Now, getting back to our water supply to the boiler, so far nothing has been said about the temperature of the water being delivered to the boiler. It should be obvious, however, that it would not be wise to pump cold water into a boiler since that would decrease the temperature of the water already in the boiler and so reduce the rate at which steam was being made. Also, the introduction of cold water might set up strains in the boiler by virtue of the great temperature difference. It, therefore, becomes expedient to heat the water to as high a temperature as possible before pumping it into the boiler. So, it is run through a feedwater heater.

The feedwater heater could be heated by a separate fuel-fired furnace but, as in the case of the air heater, it would be much more economical if it could be heated by heat that would otherwise be wasted. Suppose, for example, that the boiler feed pump was a steam driven pump, and we could use the exhaust steam from this pump. This would cost virtually nothing. So, we add a heater as shown in Fig. 7.

Fig.7



After the steam has done its work driving the pump, it is delivered to the feedwater heater, which, as shown here, is nothing more than a large tank open to the atmosphere. Hence, it is called an open heater. As will be shown later, there are other kinds of feedwater heaters called closed heaters. These usually operate at pressures above atmospheric pressure.

So far, so good; we have saved a little by using the heat in exhaust steam which otherwise would have been wasted. Let's look a bit further, however; maybe we can save some more heat somewhere else. Remember, we picked up some heat in the flue gases by means of the air heater. Have we got all of it?

Whether we have or haven't is not so much of importance because, if we want, we can modify the boiler so as to set aside one section of the tubes to heat the water before it is delivered to the boiler proper. Look at Fig. 8.

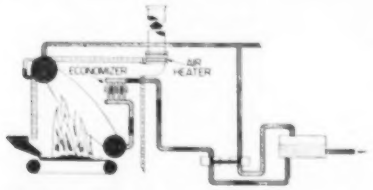


Fig. 8

Here we have added a separate bank of tubes through which the feedwater passes before it goes into the boiler drum. This bank of tubes is placed in the path of the gases traveling towards the air heater and the stack. Most of the heat in these gasses has been absorbed in the boiler tubes but not all of it. They probably still have a temperature of around 600 degrees. By making them travel through this added tube bank, still more of the heat will be absorbed. Consequently the economy of the boiler as a whole will be increased. Hence, this bank of tubes is known as an *economizer*. With this arrangement, the water is first heated to a temperature of around 212 degrees in the feedwater heater by the exhaust steam from the feed pump, and then the temperature is further raised in the economizer to a point not very far below the temperature of the water in the boiler.

Our boiler, or steam generator as it is called these days, has now become quite complex so before we do anything more to it let's hook it up to the rest of the system. As already mentioned a turbine is essentially a windmill, not a simple fan like the one shown but a more complex one with many hundreds of blades, some stationary and some rotating. These blades are arranged in groups or *stages*, so that the steam is compelled to pass successively through the various stages. A very simple diagram is Fig. 9.

In this diagram, three fans are shown mounted on a common shaft, each one in a separate compartment. Steam issuing from the nozzle in the first stage pushes against the fan blades and causes the entire rotor assembly to turn. In turning the blades in the first stage the steam gives up some of its energy, resulting in a drop in pressure. Thus, at a slightly lower pressure, it enters the second stage nozzle, and again it gives up some of its energy in turning the second stage of this rotor. After passing through the third stage in this way, practically all of the energy of the steam has been given up to the rotor and it leaves the turbine as exhaust steam.

(Part II will appear in next issue.)

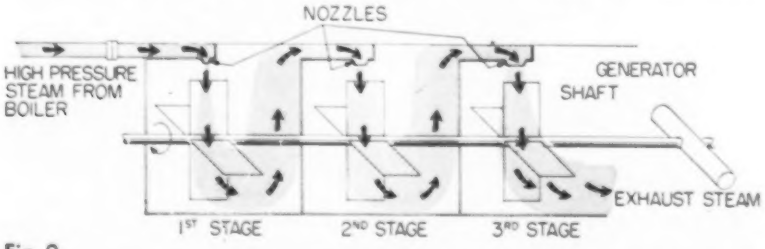


Fig. 9

fold along this line — outside edges away from you

burned on a traveling grate stoker. Air for combustion is supplied by a bellows.

Remember, when you burn coal you are really promoting a chemical reaction — a *chain* reaction. When coal is heated to a high enough temperature in the presence of air, the carbon in the coal combines with the oxygen of the air to form either carbon dioxide (CO_2) or carbon monoxide (CO). These, of course, are both gases. Which gas is formed depends upon the quantity of oxygen present. The CO means that the coal is only partially burned; indeed, the CO can be combined with more oxygen to form CO_2.

In burning coal we do not want CO because that means the coal is only partially burned; there is still energy left in the gas, energy that we can recover if we can burn it to CO_2. It is desirable, in the operation of our boiler furnaces, always to get as much CO_2 as we can because in that way we get all the heat out of the fuel.

Now we can obtain the CO_2 by supplying more air to the fuel as it is burning. But, we do not want to supply too much air because if we do, we will be supplying more oxygen than is actually needed to combine with the carbon, and this excess oxygen will play no part in the combustion process. Not only will it play no part but it will actually detract from the efficiency by absorbing heat that otherwise could be used to heat the water in the boiler. In actual practice it is not possible to supply exactly the required amount of air, so somewhat more than enough is supplied. This is commonly referred to as *excess air*.

In the process of combustion, therefore, we are dealing with chemistry. Thus, it involves a knowledge of the composition of the coal, its physical condition, its behavior under various conditions of temperature, moisture, etc. Actually, the combustion of coal is a very complex process requiring a good knowledge of both physics and chemistry. In a large plant it involves a major problem in materials handling — fuel, ashes, air and flue gas. Remember, in burning coal you have to supply about 17 pounds of air for each pound of coal used.

So far, we have merely mentioned ashes and flue gas. These have to be removed continuously. In the days of hand firing the removal of ash was simple, though laborious. The fireman merely raked the ashes out of the ashpit and carried it away in wheelbarrows. Today, in large plants, the removal of ash is a complicated process requiring rather elaborate equipment. So, we must add ash removal equipment to our diagram; also a chimney for the removal of flue gas.

Furthermore, the process of combustion is stimulated by heat; in fact, the process will not start until the fuel is brought to the kindling temperature. Everything must be done, therefore, to maintain a high temperature in the furnace. This makes it desirable to heat the air for combustion before it is delivered to the furnace. This aids combustion and increases the efficiency.

With these facts in mind, let us redraw our diagram to incorporate these improvements as shown in Fig. 3. As you see, it is becoming more complicated.

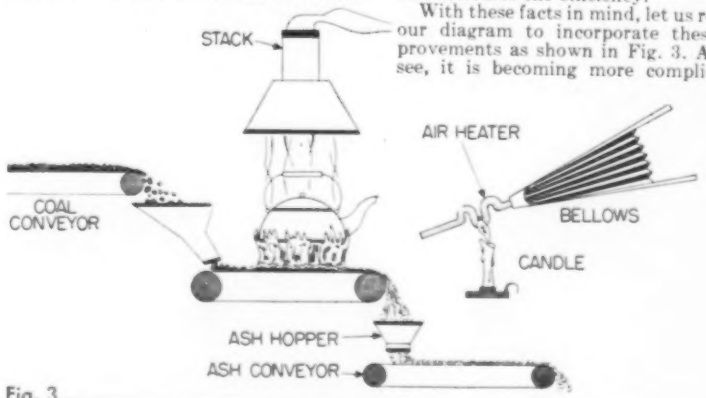


Fig. 3

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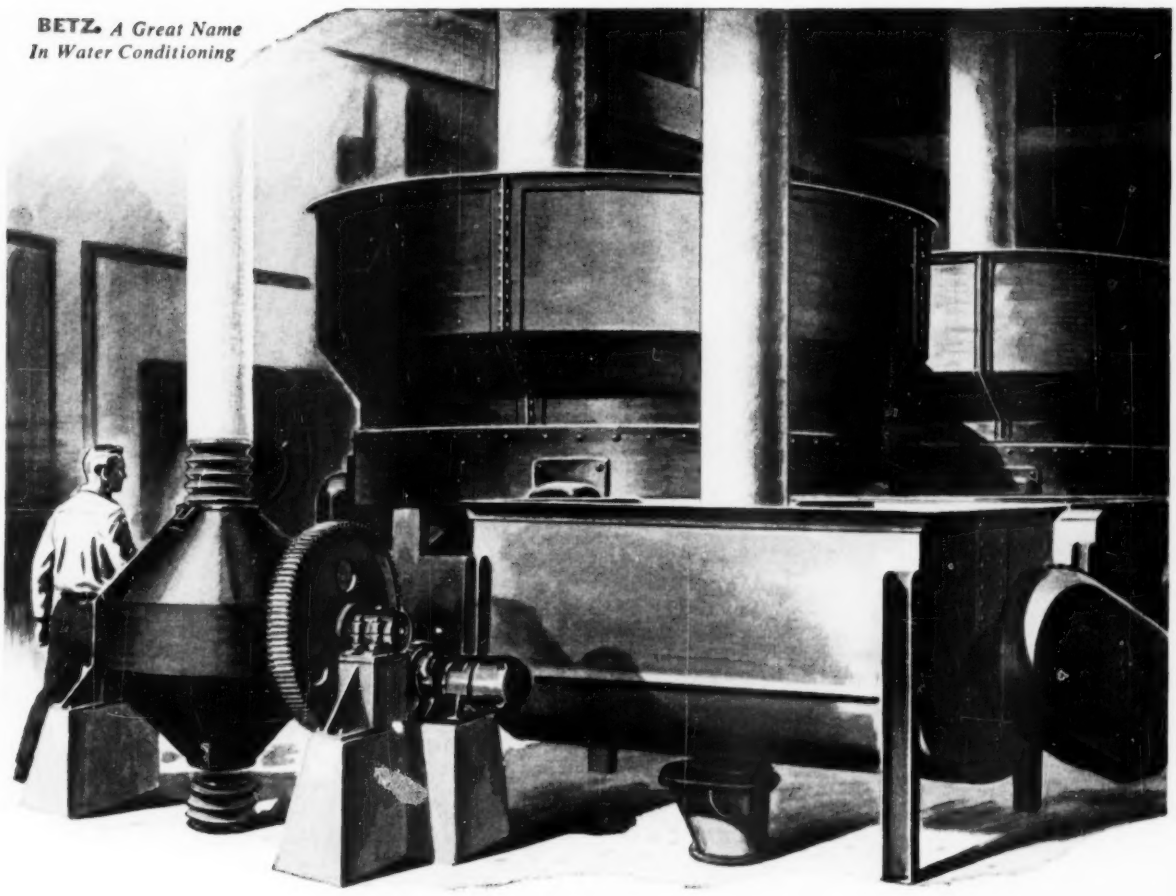

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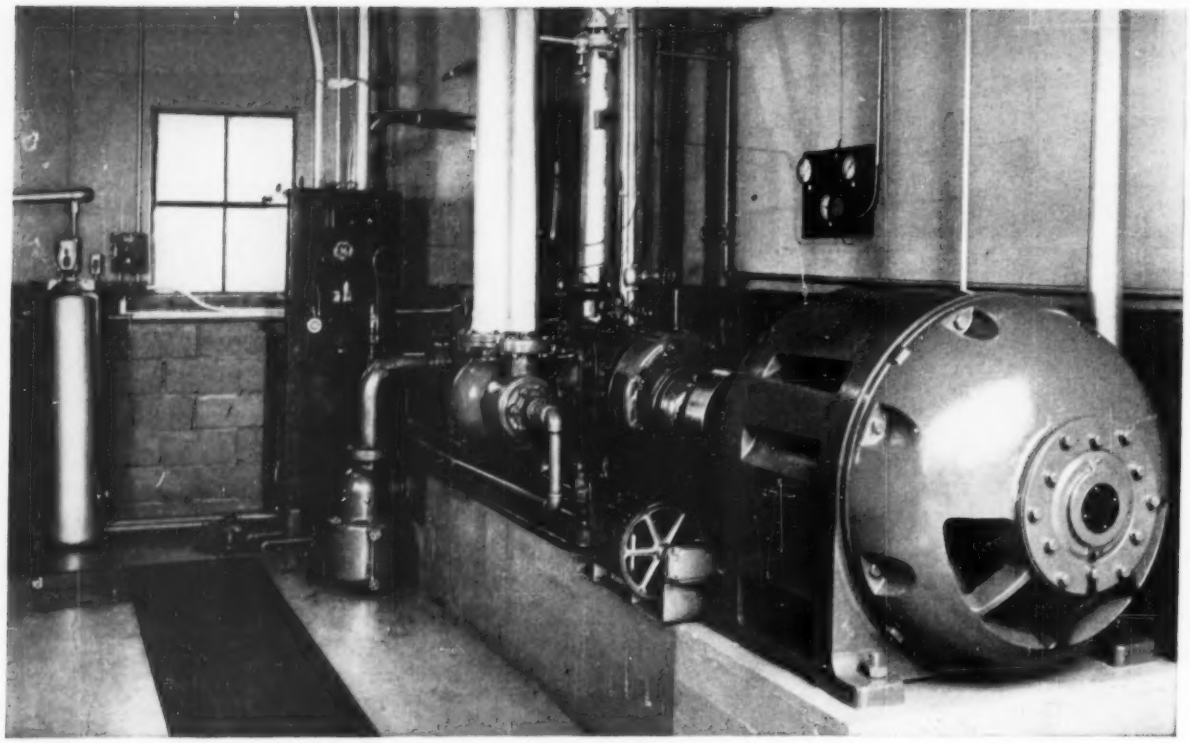

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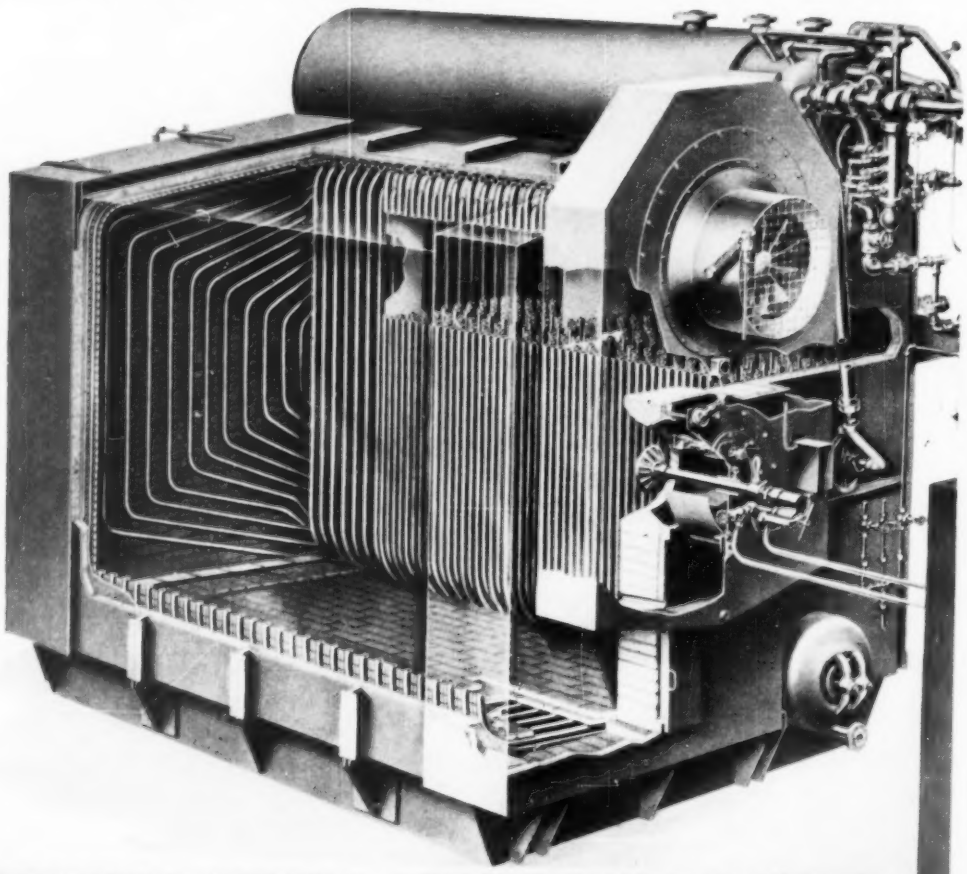

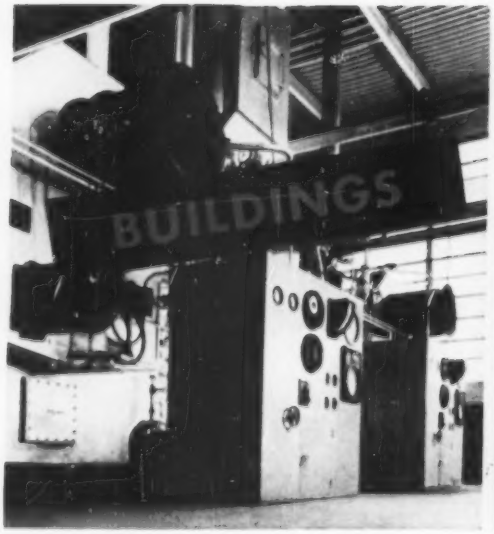

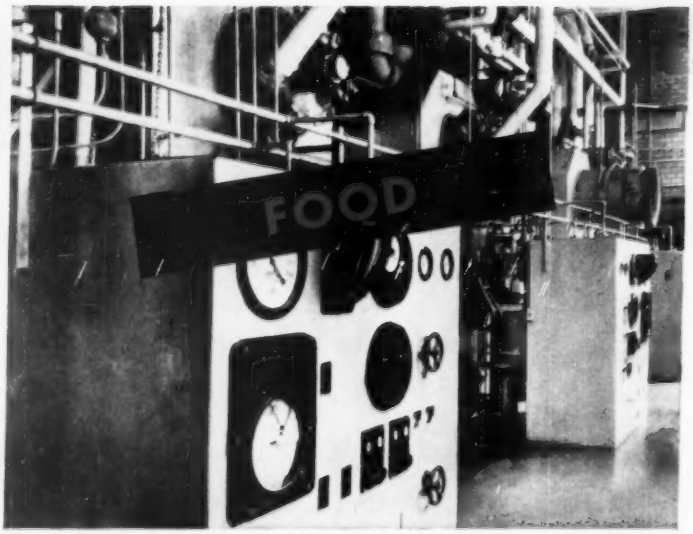

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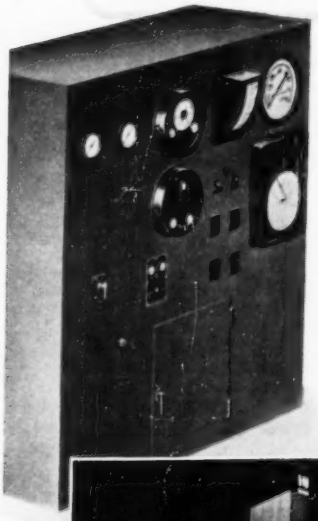

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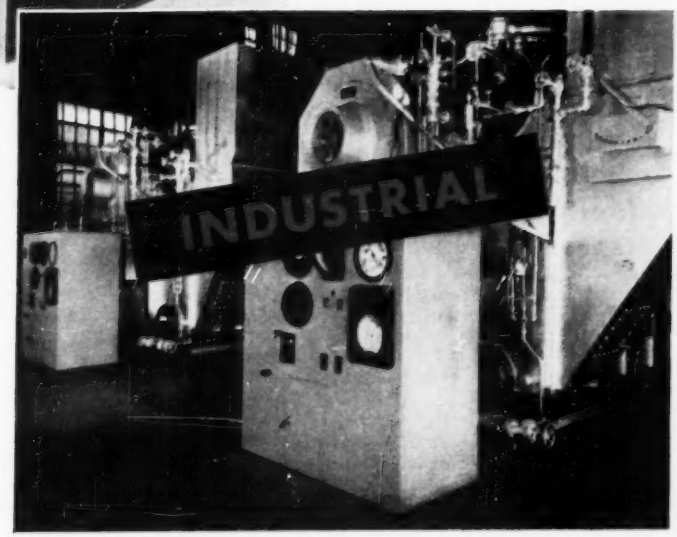

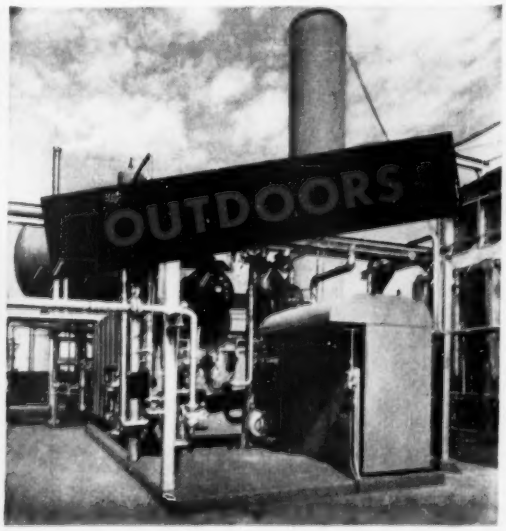

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H-T Valves, Fittings

continued from page 91

meter which is so important to combustion control and boiler operation in general. In the lower limits of the plastic range of steel, flanges can be tolerated if necessary; however in the upper range other alternatives should be sought, such as fitting the metering device, nozzle or orifice, to a pressure seal joint, for instance.

A bypass around any stop valve in the main steam piping becomes increasingly important as the steam pressure is increased, and it should be used beginning with much smaller valves than is normally the case at lower pressures.

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What Wigglers Can Do

continued from page 93

is one in which the system will hunt indefinitely, and is to be avoided.

The turbine in the above example might be in Calcutta, India and the governor in Rockford, Illinois. From the experimental (or theoretically derived) frequency response curves obtained separately for the governor and turbine, a governor designer in Rockford and a turbine customer in Calcutta can add the curves and tell whether or not the governor will work at all when it is put on the turbine to control the turbine speed, and how well it will work if the system does not hunt. If the gain and phase margins are too great, the control will be sluggish, and if too small it will be too oscillatory. A designer familiar with frequency response curves can tell a great deal more than this about the performance, and how to improve it if it is not satisfactory.

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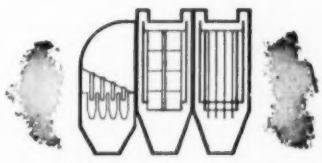
. . . the most efficient recovery equipment for high recovery, long life, low maintenance on practically any type of suspensions, wet or dry. COTTRELLS can be designed to handle a few c.f.m. —or millions—with equal ease, and at virtually any operating temperature. Recovery efficiencies closely approach 100% recovery, if desired, with very low draft loss, minimum power costs and negligible labor costs. *By all standards, Western Precipitation* COTTRELLS *give highest recovery at lowest cost per-year-of-service!*

MULTICLONE
Mechanical Collectors

. . . the most efficient, most compact, most trouble-free mechanical equipment for recovering suspensions from gases. Because of their unique small-tube design, MULTICLONES are unsurpassed in mechanical recovery efficiencies—require less space, less maintenance, and are far simpler to install. No filters or screens to replace, nothing to burn or cause fire hazards, no high speed moving parts to repair or replace. These and many other advantages make MULTICLONE Collectors the logical choice on installations where mechanical recovery is selected.



CMP UNITS
(Combination Multiclone-Precipitator)

. . . combine, in *one* compact installation, *both* mechanical and electrical recovery principles so that maximum benefit is obtained from the advantages inherent in each method. The MULTICLONE section centrifugally removes the larger and heavier suspensions (down to a few microns in diameter) . . . and the COTTRELL section then electrically removes the very small particles remaining in the gases. Thus, the bulk of the recovery is obtained with relatively low-cost equipment, and the final clean-up is obtained with equipment having unusually high recovery efficiency—approaching theoretically perfect, if desired.

The recovery of suspensions from gases is a highly exact science and every problem is different. Some require mechanical methods—others electrical methods—still others a combination of mechanical and electrical methods in proper balance to meet the individual requirements of each application. No matter what your problem, remember that only Western Precipitation has had years of field experience in BOTH mechanical and electrical methods!

Send for descriptive literature!

Let our experienced engineers study your recovery requirements and make an unbiased recommendation on the equipment best suited to your particular problem. A wire, phone call or letter to our nearest office places this unique "know-how" at your service, without obligation.

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DESIGNERS AND MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

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POWELL has a complete line of steel valves for power plants!

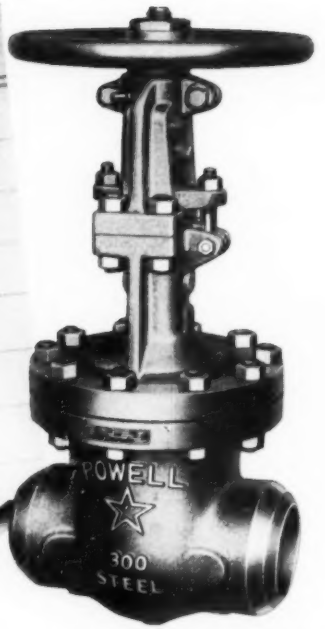

Fig. 3003-WE — CAST STEEL GATE VALVE for 300 pounds W.S.P. Bolted flanged bonnet with outside screw, rising stem and yoke. Sizes 1" to 24", inclusive.

Shown here are just a few Powell Steel Valves for power plants. Whichever type you choose, you can be certain of *dependable* flow control.

Investigate the complete Powell line—valves that have a proven record of long life and dependable service.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our complete line, and help solve any flow control problem you may have. Write The William Powell Company, Cincinnati 22, Ohio.

Fig. 1314-A—CAST STEEL INTEGRAL BONNET "Y" valve for 1500 pounds W.S.P. Also available for 2500 pounds. One-piece construction eliminates body-bonnet joint and possibility of leakage. Sizes ½" to 2", inclusive, with socket weld ends.

Fig. 11365—CAST STEEL PRESSURE SEAL HORIZONTAL LIFT CHECK VALVE for 1500 pounds W.S.P. Piston guided disc. Also available for 600, 900 and 2500 pounds.

Fig. 11303—CAST STEEL PRESSURE SEAL O.S.&Y. GATE VALVE for 1500 pounds W.S.P. Body-bonnet joint stays tight—internal pressure MAKES rather than breaks the seal. Valves of this design are also available for 600, 900 and 2500 pounds.

CONTROLS FOR THE LIFE LINES OF INDUSTRY

Powell Valves *108th year*

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What Wigglers Can Do

continued from page 102

put amplitude, deriving a family of curves.

Hi-fi fans think in frequency response terms. To say that a radio is flat to 20,000 cycles means that the magnitude ratio curve of the output sound relative to the input electrical signal is flat to 20,000 cps.

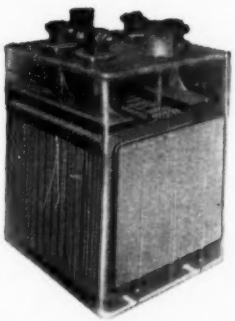
One of the most spectacular and useful functions of frequency response is in the diagnosis of troubles where all other methods fail. In this task it has always, as far as the writer knows, come through with the answers. Thus in the design of the first American guided missile, called the "Bat," the development work struck an impasse. In tests the missile missed the target by hundreds of feet. Dr. Albert Hall redesigned the controls of the elevons (which take the place of elevators, rudder, and ailerons) by Nyquist's frequency response theory. In tests the target was suspended from a cable attached to a balloon. After Dr. Hall's redesign the "Bat" on its third run cut the cable thirteen feet above the target. Since then over $2,000,000,000 worth of guided missiles have been designed with the aid of frequency response.

Practical Results

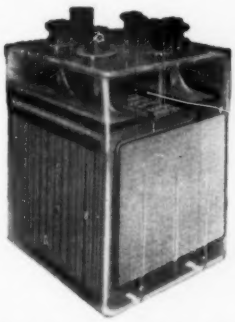
In the case of a new type of turbine where all attempts to design a governor for the turbine that would be fast enough and not hunt failed, the writer (and colleagues) proved by frequency response runs on the governor that the governor was doing exactly what it was designed to do, but that there was an excessive manifold lag in the turbine. Without appreciable suppression of this lag, acceptable governor performance was not possible regardless of what company supplied the governor. The manifold was therefore redesigned by the turbine manufacturer, which solved the problem. Too often the blame for the failure of controls is placed on the controls. Frequency response curves of the prime mover show exactly what type of control is possible.

Sometimes unsuspected prime mover dynamic characteristics show up in frequency response runs that make it necessary to modify the governor to obtain good control. After many successful experiences with frequency response, this approach has come to be heavily relied on at the writer's company. Sudden load changes or speed setting changes, pulses, and other kinds of disturbances in current use are heavily weighted in favor of low frequencies, or are impossible to produce physically to the necessary precision, or suffer other disadvantages.

The Swedish Electric Company of Sweden (abbreviated ASEA) has made frequency response runs on its entire power system to obtain the relation between the power output of



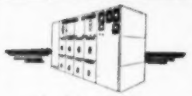
PlastiCell Type PL-29



PlastiCal Type PCL-29

NOW-2 C&D batteries for

Control



Switchgear

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Now you can have your choice of *two* modern C&D batteries—specifically designed for control, switchgear, and auxiliary power applications. The two batteries, PlastiCal and PlastiCell, are available in practically any capacity—from 10 A.H. to 770 A.H.

PlastiCal has lead-calcium grids for maximum life—conservatively engineered for 25 years in full-float service.

PlastiCell has positive plates made of high-tensile alloy grid metal for extra life and has a projected life of 14 years in float service. With both PlastiCal and PlastiCell you get:

1 **Extra-long life. Exclusive design combines advantages of both suspended and supported plate construction.**

2 **Triple insulation—thick Fiberglas mat, microporous separators, and perforated Koroseal retainer.**

3 **Saftee Vent—outstanding C&D development that prevents accidental battery explosions.**

4 **Crystal-clear plastic jars—heat-resistant and hermetically sealed.**

5 **Plastite Post Seals—easier maintenance.**

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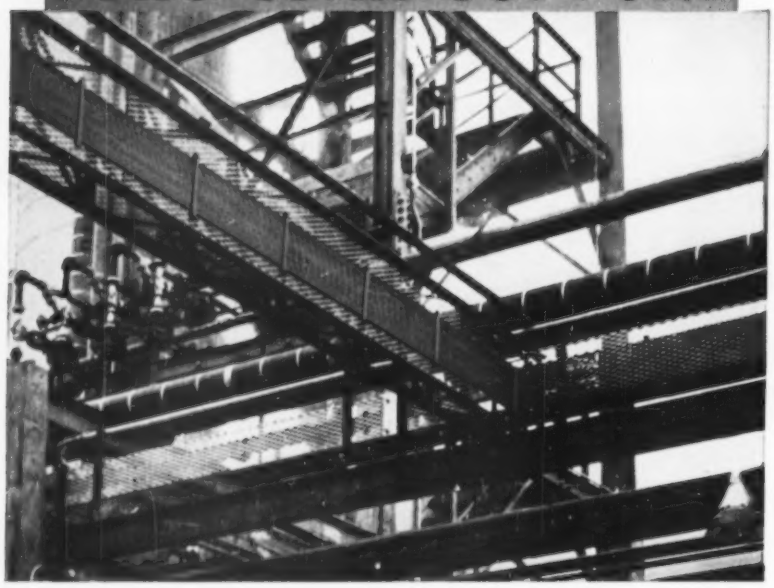

Completely fabricated flattened expanded metal Instrof now not only offers a full system for supporting instrument tubing but a system (as shown in this photograph) for spans up to 32 feet.

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What Wigglers Can Do

continued from page 105

one turbine and the frequency of the system. For these runs the generator field was varied sinusoidally. The Southern California Edison Company and the writer's company plan, in collaboration with General Electric Company, to make similar runs on the Southern California system. The ASEA tests supplied the differential equations of the Swedish system, and checked theoretically derived formulas.

The writer's company and the Tennessee Valley Authority are planning to use frequency response runs to check the differential equations of hydro systems relating turbine gate position to turbine torque. This is required for studies of governors on hydro systems.

Frequency response can be used in the production testing of governors and regulators of all kinds. This application is still in the future. The frequency response curves of controllers in production should fall within acceptable bounds. Otherwise they should be rejected. Service testing of governors and other controllers by frequency response is another possible application of frequency response. The Ontario Hydro Commission plans to make frequency response runs on governors when they are put into service. These runs will be repeated after an appropriate interval of time, such as a year. If the frequency response curves for a given governor have not changed, the governor is giving the same performance as when it was installed. If they have changed, an experienced person can often, if not always, tell what is wrong with the governor just from a glance at the curves.

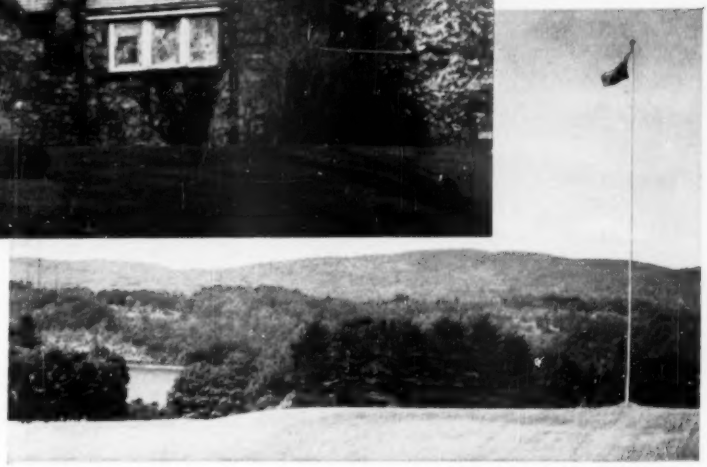
The statistical (due to Professor Norbert Wiener of the Massachusetts Institute of Technology) non-linear and frequency response domains are currently the dominant ones in the automatic control field. Frequency response overlaps the other areas playing the leading role. Knowledge of wiggling is essential for the customer as well as for the producer of automatic controls who wishes to keep up with the parade.

NEW ENGINEERING BOOKS

Correction — **The Cyclotron,** Fourth Edition, reviewed on page 132, October issue of POWER ENGINEERING, was written by W. B. Mann, not W. B. Martin. Dr. Mann is a physicist at the National Bureau of Standards in Washington and was formerly lecturer in physics at the Imperial College, University of London, and scientific advisor

SMOKELESS OPERATION...

TAYLOR, OF COURSE!



Taylor stokers at the Hudson River State Hospital, Poughkeepsie, N. Y., assure freedom from stack nuisance for this modern institution comprising 80 buildings and 890 beautifully developed and landscaped acres. Pictured above is one of the chapels; at right, a view from steps of the Main Building.

Taylor multiple retort underfeed stokers are today's first choice with state institutions, colleges, hospitals, and heating plants in the heart of cities. This is only natural, for properly engineered Taylor Stokers abolish the stack discharge nuisance once and for all—without costly dust collectors and consequent draft losses!

Furthermore, Taylor's smokeless operation is proof of superior combustion and fuel economy. Wet coals and low grade coals are no problem. Refuse is a desirable by-product instead of an added expense. And Taylor can handle widely varying loads with long-continued low steaming rates ...load variations of 20 to 1 or more are common.

The Taylor Stoker is backed by an organization with reliable service stations in Philadelphia, Dayton and Detroit...Whether your new boiler must deliver 20,000 or 500,000 lbs. of steam per hour, ask your Consulting Engineer about Taylor Stokers. And write us for a copy of free booklet giving full information about Taylor, the completely modern stoker with the old, old name. American Engineering Company, 2408 Aramingo Avenue, Philadelphia 25, Pa.

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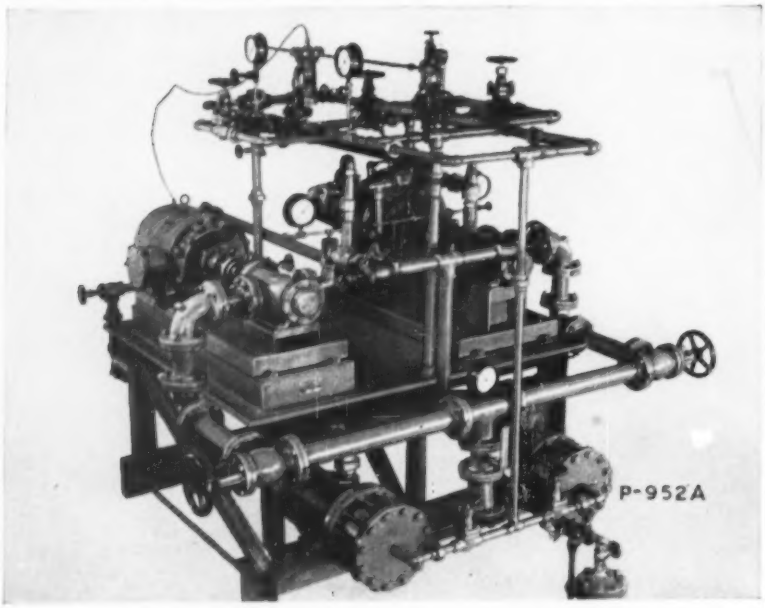

P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

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Engineering Books

continued from page 106

to the UK Delegation to the United States Atomic Energy Commission. His work, The Cyclotron, comprises a splendid, very readable little book. It is priced at $2.00, published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y.

★ ★ ★

Accident Rate Pamphlets for 1953, published by the National Safety Council, are now available. Each pamphlet summarizes the accident experience for each of 40 major industries, then gives the following information for the particular group of industries with which it is concerned: injury rates for 1953; 3-year average rates (1951–53); historical rates; rank among 40 industries; changes from earlier years; accidents by class of injury; accidents by size of unit, and for individual reporters. Then the average charge per case is given, and also lists of no-injury records. Also given, for each industry, are world records for accident-free operation, as well as industry records for the same thing.

A separate pamphlet is published for each of the following 15 industries or groups of industries: —

1. Automobile, Aircraft Manufacturing, Railroad Equipment, Shipbuilding; 2. Air Transport, Marine Transport, Transit, Storage and Warehousing; 3. Chemical, Rubber; 4. Communications, Electric Utilities, Gas Utilities; 5. Construction; 6. Food, Meat Packing, Leather, Tobacco; 7. Iron and Steel Products, Sheet Metal, Non-Ferrous Metals and Products; 8. Lumber, Wood Products; 9. Machinery, Electrical Equipment; 10. Mining, Quarry, Cement, Glass, Clay Products; 11. Petroleum; 12. Pulp and Paper, Printing and Publishing; 13. Steel, Foundry; 14. Textile; 15. Trade, Service, Miscellaneous Manufacturing.

Pamphlets are 35 cents per copy in quantities of 1–99 copies; 29 cents per comp in quantities of 100 or more when purchased by members. Prices to non-members are double.

★ ★ ★

Air Pollution Abatement Manual, Chapter 8, Manual Sheet T-9, by E. Neil Helmers; Chapter 10 Manual Sheet T-11 by R. J. Jenny; Chapter 12, bibliography; each 30 to 40 pages; size 8½ by 11 in.; paper binding; loose-leaf punching. Published by the Manufacturing Chemists Association Inc., 246 Woodward Building, 15th and 8th Sts., N.W., Washington 5, D. C. Prices: Chapter 8–75 cents, Chapter 10–60 cents.

For some time a continuous, long-range program to eliminate air pollution from industrial processes has been underway; and the Manufacturing Chemists Association has been endeavoring to co-operate with the program by issuing an Air Pollution Abatement Manual in installments.

Each installment consists of a separate

Engineering Books

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chapter treating one specific phase of the problem and written by a recognized authority on the subject. By collecting the various installments as published and binding them together, the reader will finally accumulate the complete book.

Chapter 10 begins by treating methods of abatement of gases and vapors by use of stacks, absorbers or scrubbers, incineration, catalytic combustion and adsorption. All the material in this publication is a result of practical studies by the author, who is a member of the American Cyanamid Corp.

Chapter 8 by Mr. Helmers, who is air pollution consultant for the du Pont Co., discusses effects of weather on air pollution in detail. To assure most economical solution to the problem, cost of reducing emission must be weighed against increased stack height or meteorological control of emission rates.

Chapter 8 also discusses applications of meteorology to air pollution control engineering, the determination and effects of atmospheric diffusion and other related subjects. It includes some unusually good photographs of various types of smoke plumes.

Chapter 12, edited by C. A. Gosline, supplements the references originally compiled in Chapter 12 published in 1952. A new classification has been added to include material on lawsuits.

★ ★ ★

Techniques of Plant Maintenance and Engineering 1953 (L. C. Morrow, consulting editor); 288 pp; cloth binding; size 5½ by 11¼ in. Published by Clapp & Poliak, Inc., 341 Madison Ave., New York, N. Y. Price $6.00.

This single volume is a compilation of the Proceedings of the Technical Society for the Advancement of Management, held concurrently with the Fourth Plant Maintenance Show at Cleveland, 1953. (Copies of Techniques of Plant Maintenance for 1951 and 1952 are still available; the 1950 edition is out of print.)

Maintenance Essentials were presented at the general session with sectional conferences covering the subjects of Works Engineering Organization, Maintenance Operating Policies, Preventive Maintenance, Maintenance of Buildings, Mechanical Equipment, Electrical Equipment, Power Plant Maintenance and Corrosion Prevention and Control.

Top maintenance men in large plants (with over 800 maintenance employees) medium-sized plants (101 to 800 employees) and small plants, also gave detailed descriptions of their operations, as well as their specific problems encountered in plant engineering. Their reports afford a wealth of diversified and practical data. Additional problems were solved in the valuable "Question-and-Answer" periods that followed each session. All of these are included.

The speakers were generally in complete

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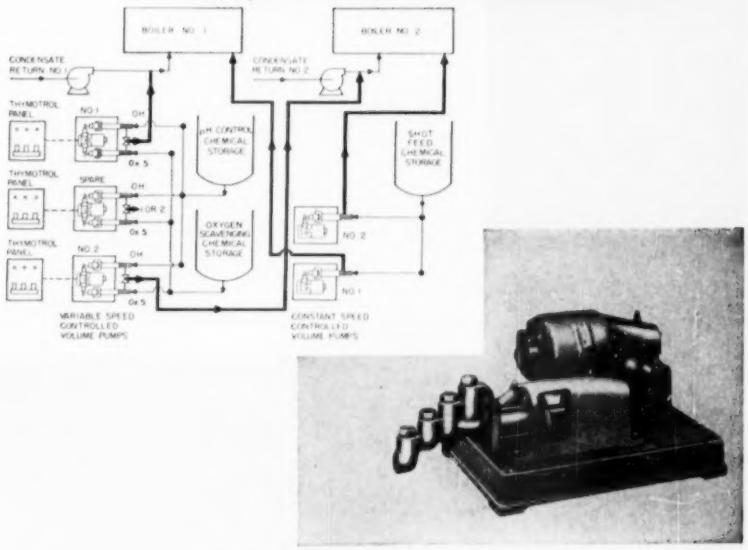

Major utility standardizes on controlled volume pumps

Philadelphia Electric utilizes Milton Roy pumps in connection with the boiler feed water treatment system in each of its seven power stations.

Standardization proves profitable. Automatically controlling the metering of treating chemicals, this universal treatment method assures complete control over many problems of power plant operation.

Flow-control instrumentation of this type is representative of the use of Milton Roy Controlled Volume Pumps. Other applications include flocculation control in clarifiers, corrosion control in boilers, and pH control.

Similar systems can help you solve *your* low-capacity flow control problems. Write for Data Sheet D-54-2 which describes fully the Milton Roy System . . . and Bulletin 553, "Motor-Driven Pumps."

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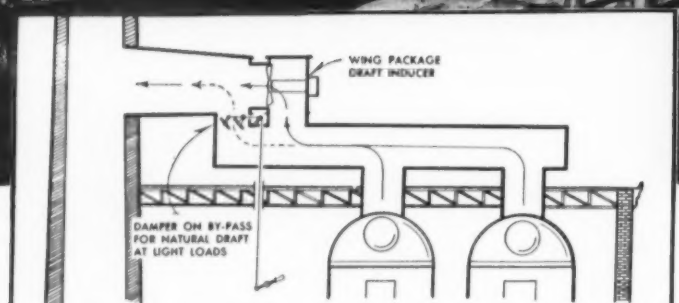
The WING Package DRAFT INDUCER



WING PACKAGE POWER PLANT DRAFT INDUCER at WELCH GRAPE JUICE COMPANY'S PLANT AT WESTFIELD, N.Y. SERVES TWO 20,000 lb./hr. BOILERS. NOTE (A) INDIVIDUAL CONNECTION FROM EACH BOILER (B) BY-PASS WITH DAMPER CONTROLLED FROM BOILER ROOM, PERMITTING NATURAL DRAFT AT LOW LOADS (C) RELATIVE LIGHT WEIGHT AND COMPACT PACKAGE DESIGN PERMITS SUPPORT ENTIRELY ON COMMON BREECHING.

The WING Package DRAFT INDUCER is unique in that the motor (or turbine) and fan is designed as one complete removable unit, making installation easier and being easily removed, facilitates inspection and maintenance. Other advantages are:

1. Big savings in space requirements
2. Permits fewer and lighter structural supports
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5. Only two support bearings
6. Wide flexibility in gas outlets
7. Saves on investment and maintenance
8. Low load ratings on natural draft because of ample free gas travel area

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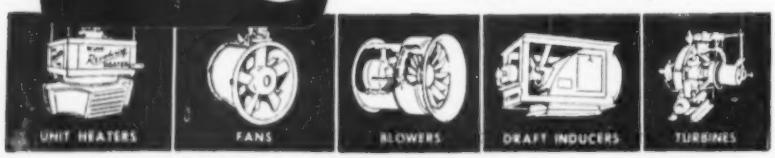

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Engineering Books

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agreement on the importance of a sound preventive schedule with periodic inspection and repair. Organization of personnel was considered a first step in getting efficient maintenance, particularly in smaller plants where duties are so varied. This is preceded, of course, by the right kind of organizational plan.

Especially interesting was the address on Power Plant Maintenance by Charles I. Fishkin (Plastics Division of Monsanto Chemical Co.), who outlined the principles he would follow in developing a program to insure cheap and dependable power for the manufacturing plant.

★ ★ ★

Theoretical Nuclear Physics, by John N. Black, and Victor S. Weisskopf; 1st edition, 864 pages, 6¼ x 9¼ ins.; cloth binding. Published by John Wiley and Sons, 440 Fourth Ave., New York, N. Y. 1953. Price $12.50.

With increasing emphasis on the development of atomic power plants in this country, as well as in other parts of the world, it becomes expedient for power engineers to become somewhat familiar with the basic concepts of nuclear physics, at least to the extent of being able to understand the practical application of these concepts in power reactor designs. Of course, nuclear physics is a highly specialized and complex branch of modern science, and it is not to be expected that power engineers will become nuclear physicists. Nevertheless, there is much about nuclear physics that engineers can become familiar with, and this book is one of several similar volumes which have appeared recently which will help engineers in obtaining a better understanding of nuclear physics.

Fans for Outdoor Plants

continued from page 85

a spurt in designing for much increased thermal efficiencies. The additional heat recovery equipment needed to obtain these higher efficiencies creates additional draft losses, consequently fan design pressures are higher. The increased use of pressurized furnace steam generators also calls for high pressure forced draft fans.

The noise level of a fan is largely dependent on the pressure developed by the fan. While there is some variation in noise level between fans of different blade types, it is impossible for the fan designer to reduce fan noise appreciably without sacrificing efficiency of operation. After all, the construction of an ordinary centrifugal fan differs only slightly from that of a conventional siren! *cont. on page 112*

Pennsylvania R. R. saves $33,000 a year by burning coal the modern way

The Lafayette Street Power Plant of the Pennsylvania Railroad in Fort Wayne, Indiana, heats a passenger station, office buildings and repair shops. In addition, it also supplies steam for power, processing and car heating. To increase the efficiency of this coal-fired plant, the railroad replaced its old boilers with modern steam generating equipment, regulated by automatic combustion controls. At the same time, they modernized the ash removal system.

Today the cost of steam generation has been lowered from 77c to 59c per 1,000 pounds and combustion efficiency raised 25% higher than before. Overall heating costs have been cut $33,000 yearly.

Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one – or if you are just interested in cutting fuel costs–find out how coal, burned the modern way, compares to other fuels. Talk to a consulting engineer or your nearest coal distributor. Their advice may save you thousands of dollars every year.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available.

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

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Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

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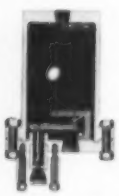
JUST SPECIFY Clark CONTROLS

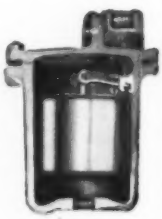
Thanks to the proven dependability and completeness of the Clark steam trap and regulator lines, power engineers can meet most of their requirements simply by calling a Clark representative. For there's a "right" Clark steam trap for every purpose.

Clark makes the famous patented Duo-Step inverted bucket traps that handle *double* the usual amount of condensate. In addition, Clark manufactures open bucket and float type traps as well as pressure regulators and strainers.

So call on Clark for *all* fluid control requirements. There are Clark representatives in most major cities.

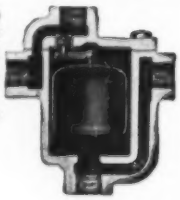


SERIES "450" FLOAT TRAP. For drainage where continuous flow is desired, or for maintaining liquid levels. Steel construction for pressures to 600 P.S.I. Compound linkage gives larger capacity. Size ½" to 2".



SERIES "80"-D (DUO-STEP) TRAPS. Cast semi-steel construction for pressures up to 250 P.S.I. and temperatures to 450°F. Equipped with Duo-Step Leverage and Venting, Clark-loy seats and discs. Pipe sizes from ½" to 2".

"Y" SELF-CLEANING STRAINERS. Remove dirt, scale and grit from steam, fluid and gas lines. Sizes ½" to 3" I.P.S.



SERIES "60" INVERTED BUCKET TRAP. Choice of horizontal or vertical inlet or outlet. For pressures up to 150 P.S.I. "Clark-loy" guided disc and seat.

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Fans for Outdoor Plants

continued from page 110

The degree of nuisance caused by the fans in an outdoor plant depends upon their specific noise levels and predominant frequencies, noise levels and frequencies of other plant equipment, location relative to the other equipment and to the surrounding residential areas. Under the present state of the art of noise prediction and measurement, it is not always possible to entirely prevent noise troubles from developing. With the added space available in an outdoor plant, it is possible to utilize larger, slower speed fans which reduces noise levels somewhat. In the cases where fan noise troubles arise after an outdoor plant is put into operation, it is usually possible to install sound absorbing material near the fans or to build shielding walls between the fans and the source of complaints. At the present time, development of the art of noise prediction and elimination seems to be growing at a faster rate than the "noise-consciousness" of the general public, so that in a few years it may be possible for the power plant designer to confidently plan outdoor plants which will not give trouble from this source.

Location of the fans on concrete slab foundations on the ground level is very beneficial from the standpoint of vibration. This is especially true of induced draft fans which may become unbalanced in service from wheel erosion or dust buildup. By comparison with the usual indoor location on one of the upper levels where light foundations without sufficient damping were often used, the ground level locations contribute immeasurably to smoother running fan units.

In most of the outdoor plants, the fans have been so located that they are very accessible for maintenance operations. Rotor replacement, which was often made extremely difficult in indoor plants due to nearness of other equipment or building walls, is now made relatively simple by the use of power cranes.

While it would seem that attention to the fans of outdoor plants by the operating personnel might be somewhat less than in an indoor plant, especially in bad weather, this has usually been offset by additional instrumentation Bearing temperature indicators and alarms have eliminated the necessity for painstaking periodical rounds of the fans and other equipment.

In general, the mechanical draft fans have benefited in the move to outdoor power plants. Better performance is obtained with the unfettered duct layouts, and ground-level foundations have made possible smoother operating fans. While bearing reliability has decreased slightly due to weather extremes, future development work should offset this.

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ELECTRICAL EQUIPMENT

201 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control. Allis-Chalmers Mfg. Co.

202 Motor Lubrication — Three methods of lubricating electric motors — cartridge, standard open and company's Lubriflush — are compared in 8-pp Bulletin 1848. To demonstrate action of relubrication in Lubriflush bearings, a series of natural color photos of a transparent bearing housing is reproduced. Necessity of annual lubrication is demonstrated photographically. U. S. Electrical Motors Inc.

203 Wire, Cable Ordering Guide — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A technical engineering data section is included. Available to qualified power engineers. United States Rubber Co.

204 High-Capacity Fuses — Form HCS, 6 pp, describes fuses of unlimited interrupting capacity on voltages to 600, designed to afford protection for loads of 600 to 5000 amp. Includes test data, charts on opening time, current limiting effect. Bussmann Mfg. Co.

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205 Power Distribution Practices — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution practices in large and small plants. Covers utility distribution practices; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

206 Insulation Temperature-Resistance — Technical Publication 21T4, 16 pp, is an article on temperature-resist-

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ance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics, composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, dielectric absorption characteristics, and a practical method of obtaining insulation temperature. James G. Biddle Co.

INSTRUMENTS AND CONTROLS

207 Instruments for Steam Generation — Bulletin 9050, 32 pp, is a handy reference for all manufacturer's products applicable to steam generation, including electric, pneumatic, electronic and mechanical types of instruments and controls. Power engineers will find it useful in selecting instrumentation for modernization of package boilers. Minneapolis-Honeywell Regulator Co.

208 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate equipment. Bailey Meter Co.

209 For Feedwater Analysis — Bulletin 148 BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O_2 and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

210 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feed water automatically according to steam flow. Copes-Vulcan Div., Continental Foundry & Machine Co.

211 Transmitter Unit — Bulletin 9563M describes and illustrates a pneumatic signal transmitter for use with company's ring balance meter. Using a schematic diagram of the operating mechanism, booklet explains how speed, accuracy and stability of the transmitter, in combination with the ring balance meter, provides an instrument adaptable to a wide variety of metering and control applications. Hagan Corp.

212 Gage Cocks — Quick-opening and self-closing gage cocks in models designed for pressures up to 250 lb and 450 lb, and a wood wheel gage cock designed for pressures up to 150 lb are described in this illustrated folder. Explains construction, applications. The Paul B. Huyette Co., Inc.

213 Water Level Indicators — Bulletin WG 1824, 20 pp, revised, describes three models of remote liquid level indicators for boilers, heaters, storage tanks and other vessels in power and industrial process plants, for boiler pressures up to 700, 1500 and 2500 psi respectively. Illustrates a new wide vision dial, an indicator installation, and electronic secondary indicators. Explains how indicator is used, gives typical applications, wiring diagrams. Yarnall-Waring Co.

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PUMPS, PUMPING

214 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

215 Controlled Volume Pumps — Motor-driven controlled volume pumps are fully described in 40-pp Bulletin 553. Provides information on design and construction of the pumps, and includes capacity-pressure selection tables, types of capacity adjustments, standard and special designs and packaged systems. A chart shows typical applications in six major industries, and another chart, in full color, shows construction materials suitable for use with some 170 industrial fluids. Milton Roy Co.

VALVES, TRAPS, PIPING AND ACCESSORIES

216 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

217 Lubricated Plug Valves — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.

218 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

219 Butterfly-Valves — Construction details, engineering and application data on butterfly valves are provided in three illustrated bulletins. Eight-pp Bulletin 557 covers those of standard heavy-duty construction; Bulletin 558, 8 pp, those of standard medium-duty construction; and Bulletin 559, rubber-lined butterfly valves. W. S. Rockwell Co.

220 Blow-Off Valves — Bulletin B-426, 20 pp, on blow-off valves for boiler pressures up to 400 lb wsp, contains installation recommendations, construction information on Yarway seatless and double-tightening blow-off valves. Gives full ordering data. Yarnall-Waring Co.

221 For Precise Control — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manual and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages are discussed. R. S. Valve Div., S. Morgan Smith Co.

222 Pump Valves — Sixteen-pp Catalog SC-510, now available to power engineers, describes and illustrates valves made to fit practically all makes of reciprocating pumps. Key features of the valves

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are discussed, and standard, lock-in and deck types are covered in detail. Sims Pump Valve Co., Inc.

223 Choosing the Right Valve — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are also discussed and the importance of stem operation is treated. A final chapter is devoted to common materials of valve construction. Crane Co.

224 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

225 Steam Trap Solutions — Bulletin F.151, 36 pp, is a newly revised edition of this company's well known booklet, "Solving Steam Trap Problems." Organized for easy reference, this illustrated booklet provides specifications and capacities of steam and float traps, air release valves, pipe line strainers. Tells how to calculate condensation loads and select traps for unit heaters, jacketed kettles, submerged surfaces. Gives pointers on installing and servicing traps. The V. D. Anderson Co.

226 Industrial Steam Traps — Twelve-pp Bulletin 853 describes steam traps with bellows of bronze, Monel or stainless steel, and bodies in bronze, semi-steel and cast steel construction in sizes ¼ to 2 in., for pressures from vacuum to 300 lb. Included besides capacity tables and dimensions are piping diagrams, typical applications. W. H. Nicholson & Co.

227 Unions and Valves — Catalog 11, 24 pp, contains full engineering data and specifications on company's Perfect Seal line of hot forged steel pipe unions and swing check valves. Also lists alloy steel and stainless steel unions, and a special section is devoted to double-start unions. Catawissa Valve & Fittings Co.

228 Unions and Fittings — Twelve pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

229 Forged Fittings — Literature is available on screw-end and socket-weld fittings. Stresses economy and other advantages of these fittings, lists steels available. Watson-Stillman.

FUEL OILS, LUBRICANTS

231 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. A chart shows relation of

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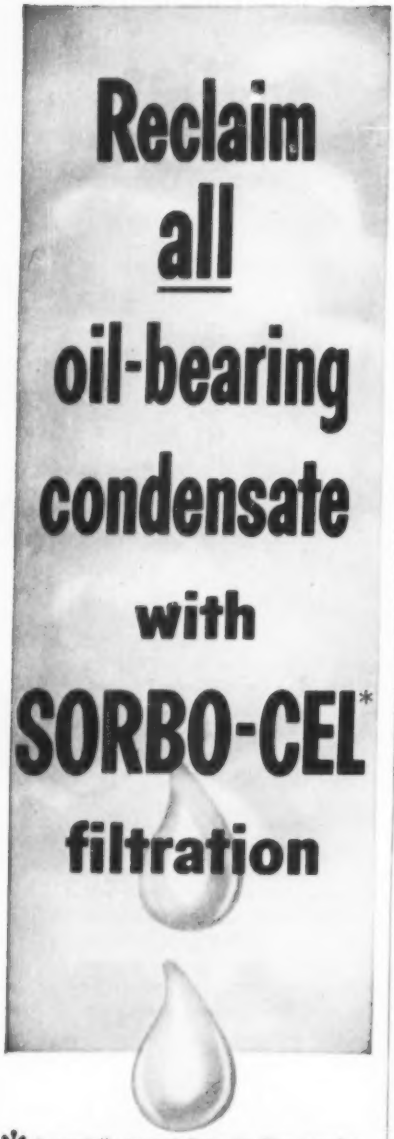

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engine performance to fuel properties. Sinclair Refining Co.

232 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations. DeLaval Separator Co.

233 Petroleum Pitch — This illustrated article on petroleum pitch as a boiler fuel stresses its low cost, other advantages. Explains combustion of pitch; discusses unloading method, burning, storage, fuel oil treatment, also precautions in handling hot pitch. Kor Corp.

234 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, also safety precautions. Cities Service Petroleum, Inc.

235 Bearing Lubrication — Vol. XL, No. 10 of this company's Lubrication magazine provides an excellent 12-pp article on industrial bearing lubrication. Illustrated with photos and drawings, text covers such subjects as bearing design; bearing surfaces; bearing overhaul; aspects of lubrication, including factors involved in choice of turbine oils and diesel lubricants, and the deletorious effects of moisture; and the life expectancy of bearing lubricants. The special requirements of porous bearings and applications in which grease lubrication is advantageous are also discussed. The Texas Co.

BOILERS, GENERATORS

236 Efficient Little Boiler — Bulletin AD-135 describes company's CB 50-80 boilers available in 50 to 80 hp (15 to 150 lb steam, 30 lb hot water) for heating and processing. Stresses such advantages as silent operation, fuel flexibility, speed, easy maintenance, and automatic operation. Discusses new hinged front and rear doors, forced draft systems, other features. Includes drawings and specifications. Cleaver-Brooks Co.

237 Shop Assembled Boilers — Two-drum, bent tube package units for steam and high pressure and high temperature hot water are the subject of this illustrated bulletin. Gives construction details, dimensions, ratings. Springfield Boiler Co.

238 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cut-away illustration shows design details, and gas travel. Erie City Iron Works.

WATER CONDITIONING

239 Steam System Treatment — This bulletin on Coravol for prevention of corrosion, explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

240 Boiler Water Manual — Factual information on methods of applying chemicals in treatment of water for boilers is presented in 16-pp Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and feedwater system, condensate returns. %Proportioneers, Inc.%

241 Feedwater Treating — Bulletin 1855, 30 pp, features manufacturer's hot process Accelerator for treatment of boiler feedwater, illustrating and explaining its operation and advantages, also optional equipment. Contains excellent discussion of necessity for treatment of makeup water, selection of proper equipment. Also covers the limitations of hot process softening. Infilco Inc.

242 For Industrial Water Softening — Greensand, zeolite and resinous exchange water softeners are described in 8-pp Form 8-105. Discusses features and applications of each of these basic types and illustrates some installations. Includes capacity data and general specifications. Also describes and pictures controls for water softeners, pressure filters and deionizers. Illinois Water Treatment Co.

243 Testing Equipment — Designed for use as a guide in the selection of water testing equipment, this 12-pp bulletin de-

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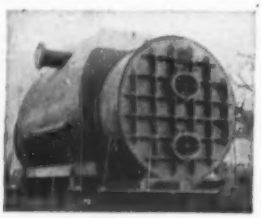

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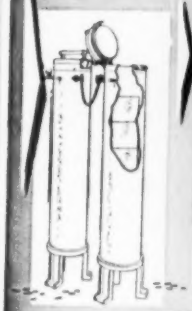

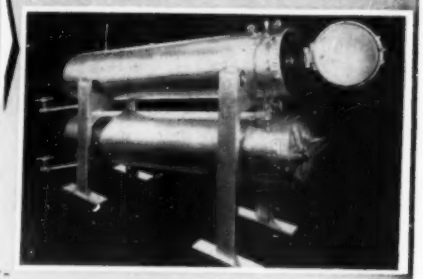

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TUBING AND ACCESSORIES

244 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

245 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

246 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Air valves, hose, lubricators are described. Thomas C. Wilson, Inc.

247 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

248 Data on Stress Values — Data Card 154 is designed to help power engineers concerned with the operation of tubular equipment at elevated temperatures and pressures. The card is an adaptation of Table P-7 of the new ASME Boiler Code and is complete with notes and formulas for calculating maximum allowable working pressures. Tubular Products Division, The Babcock & Wilcox Co.

COAL HANDLING

249 Pneumatic Handling System — of value to power engineers concerned with the handling of dry pulverized materials, 16-pp Bulletin G-2 tells how handling costs can be reduced by using the proper pneumatic handling system. Lists 86 dry pulverized materials and indicates which of three systems is best suited to handle each material. Discusses company's system for conveying such materials as Portland cement, pulverized coal. Fuller Co.

250 Coal Crusher — Company's WC and WS series rolling ring coal crushers are described in Bulletin 154. Emphasizes special construction elements that mean greater coal reduction at lower operating costs. Cross section illustration shows both feeding and crushing action incorporated and tables give capacities, speeds, and dimensions. American Pulverizer Co.

251 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

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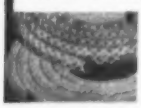

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252 Spreader Stoker — Sixteen-pp Bulletin 800 describes manufacturer's Type C-C RotoStoker, a relatively small spreader stoker offering continuous cleaning and ash discharge advantages of larger units, without need of a basement for ash-removal. Explains this and other operational advantages of the stoker, which is adapted to modern steam boilers with output capacities of about 5000 to 75,000 lb of steam per hour. Detroit Stoker Co.

OTHER EQUIPMENT

253 Refrigerator Condensers — Bulletin RC-2, 38 pp, utilizes drawings, tables and engineering data to show how to select proper type from company's line of ammonia and Freon condensers for refrigeration services. Illustrates horizontal multipass shell and tube types; vertical singlepass shell and tube types. Gives pipe sizes for ammonia and Freon lines; stands for large and small condensers. Henry Vogt Machine Co.

254 Turbine Speed Control — Thirty-pp wire-bound Bulletin H-21 is titled, "Fundamentals of Turbine Speed Control." It is an elaborately illustrated, educational booklet intended to clarify the operation of common types of automatic speed control for steam turbines. An introductory section covers general fundamentals of automatic control systems, and includes a key to control terminology. Simplified diagrams show operating principles of actual control systems. Elliott Co.

255 Dry Ice Converters — This illustrated bulletin describes pressure vessels with removable closures into which dry ice is charged and in which the resulting carbon dioxide is stored indefinitely under pressure. Gives advantages of CO_2 for purging or use as an inert gas, and advantages of the dry ice converters as a source of CO_2. Dry Ice Converter Co.

256 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

Postage-free cards for ordering these catalogs are provided on pages 113 and 114. When using them, don't forget to include your job title and company name —even if you want your catalogs to be delivered to your home address

257 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metal working operations, processing, fuel oils, dust control. Gulf Oil Corp., Gulf Refining Co.

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258 Industrial Products Guide — Newest edition of this company's industrial products catalog is a 40-pp book offering essential data on insulations, refractory products, asbestos cement pipe, packings, gaskets, electrical products, frictional materials, and others. Photos, diagrams, and text have been brought up to date. Johns-Manville.

259 Power Plant Equipment — This comprehensive folder illustrates some of the equipment and services provided by this company. Shows heat exchangers, filters, condensers; also such services as re-tubing and metal spraying. Condenser Service & Engineering Co., Inc.

260 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Industrial applications for other than power boilers are also covered. Air Preheater Corp.

262 Industrial Equipment — Bulletin WP-1099-B61, 16 pp, describes manufacturer's industrial equipment including centrifugal refrigeration, condensers and coolers, steam power plant equipment, water conditioning deaerators and rotary pumps. Worthington Corp.

263 Motorized Chimney Draft — The advantages of mechanical draft in supplying positive, uniform, adequate draft, regardless of variable weather conditions or inadequate chimney or breeching construction are shown in detail in Bulletin I-52. L. J. Wing Mfg. Co.

264 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

265 Steam Valve Calculator — A slide-chart calculator that quickly estimates pressure drop and indicates proper size steam valve needed for any pressures up to 1500 psi is now available. Printed on calculator are operating instructions. Golden-Anderson Valve Specialty Co.

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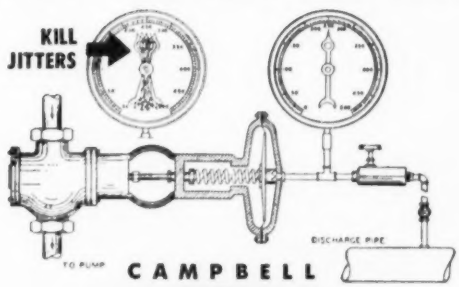

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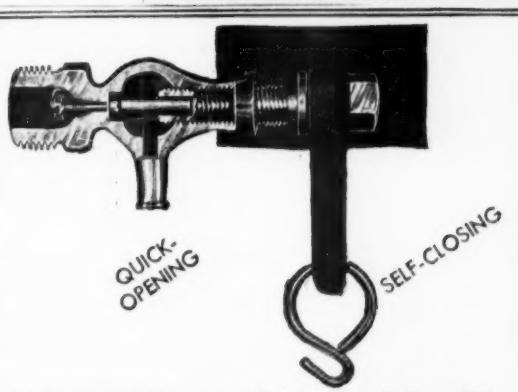

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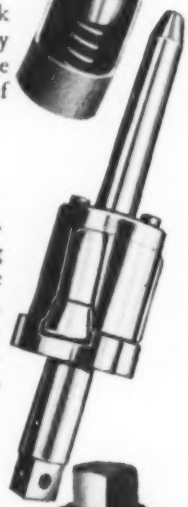

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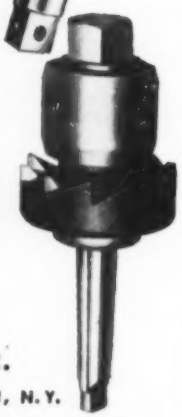

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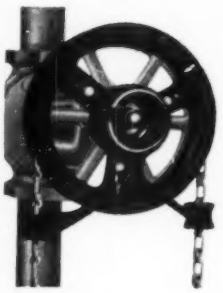

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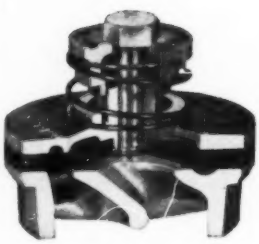

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POWER ENGINEERING

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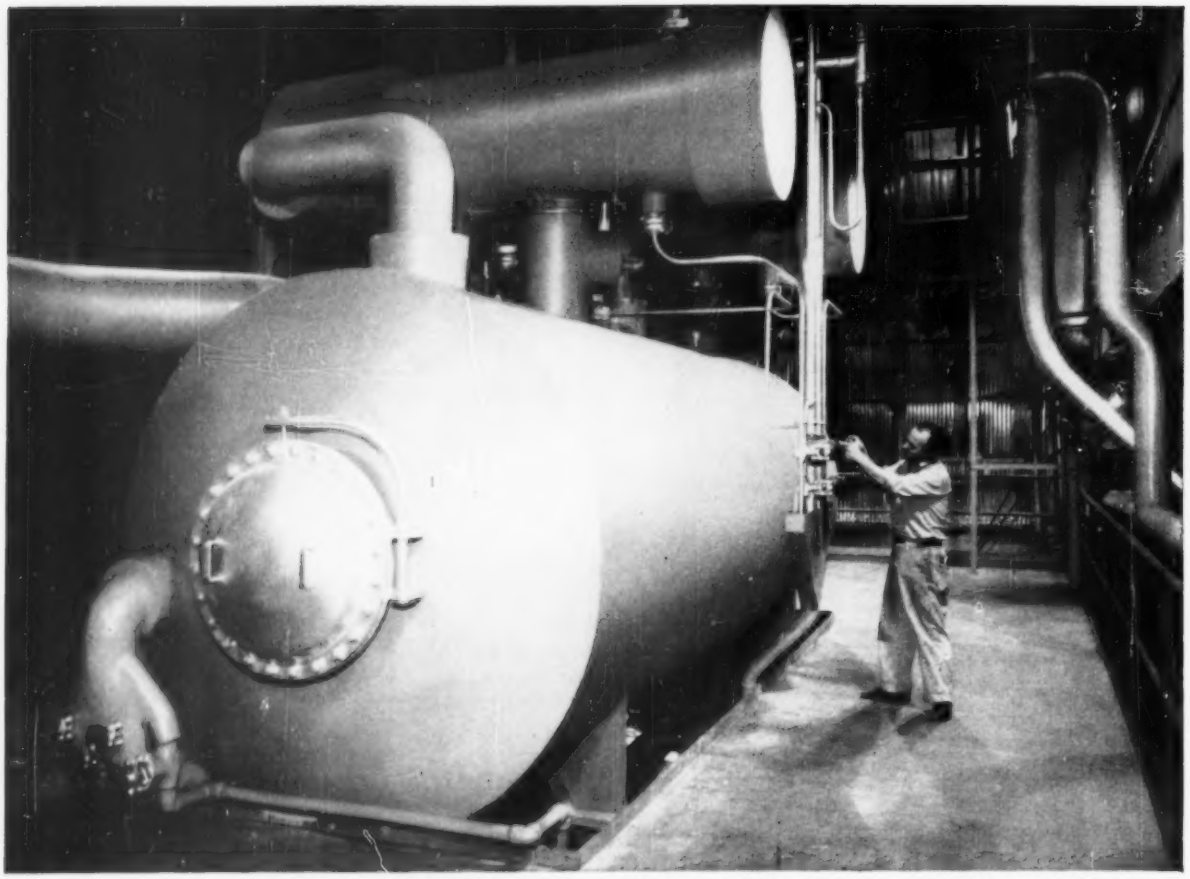

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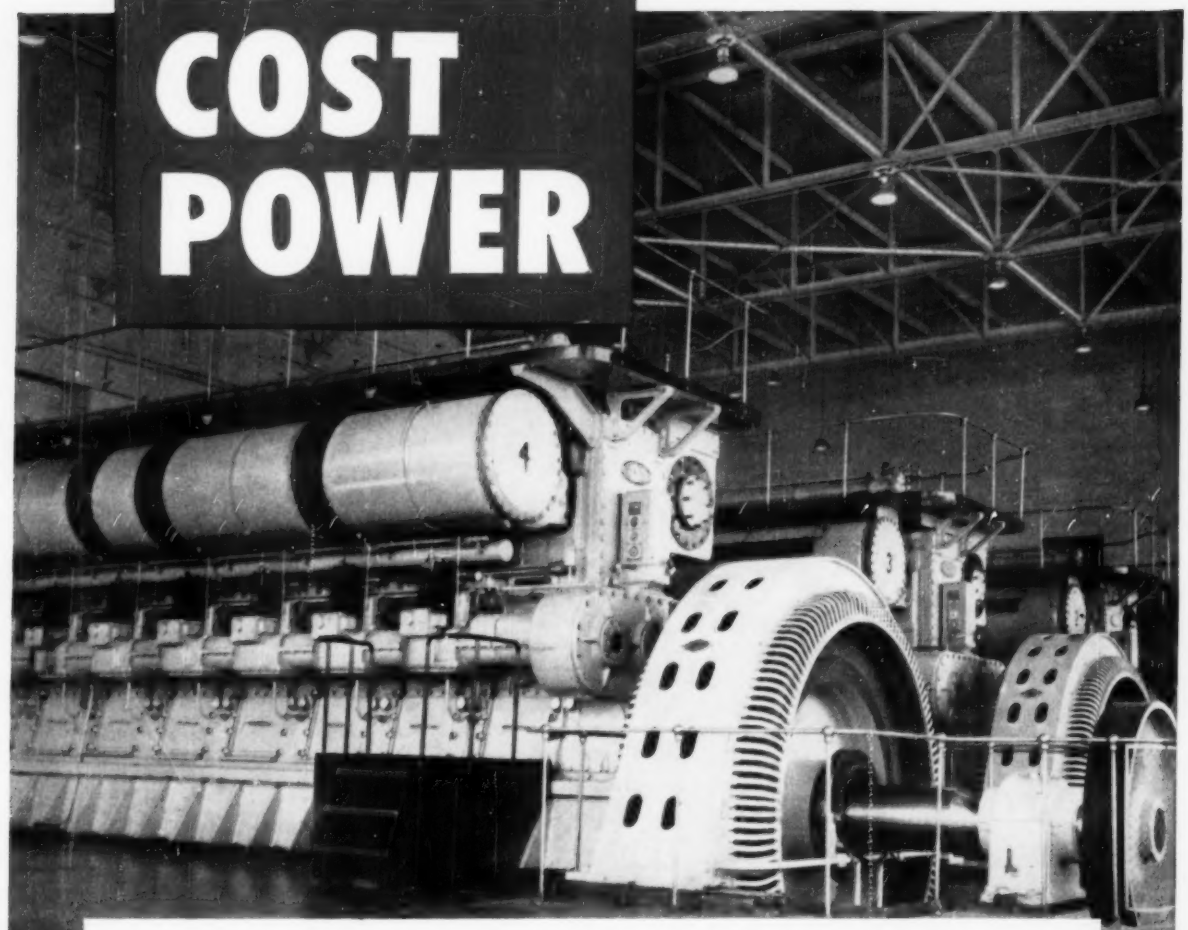

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